THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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THE M.E.A. CONVENTION.

THE ninth annual Convention of the Municipal Electrical Association has so far been attended with gratifying success. We give elsewhere a brief report of the opening proceedings, and will confine our remarks in this place to the presidential address of Mr. T. P. Wilmshurst. The President pointed out the remarkable fact that in eight years the capital outlay of the undertakings controlled by the members had increased from £4,000,000 to £25,000,000, or including tramways, to £40,000,000. After referring sympathetically to the untimely death of Mr. Quin, Mr. Wilmshurst drew attention to the lack of continuity in the policy of Parliamentary Committees in relation to municipal undertakings, more especially with regard to the respective powers of local authorities and power distribution companies to supply electricity within and without the areas controlled by the former. In 1900 the principle was laid down that companies should not be allowed to compete with the local authorities where an adequate municipal service was provided; nevertheless, the city of Bristol, which is well furnished with light and power supply, was included within the area of a power company. We may point out that the company can supply only power consumers with electrical energy, though up to 50 per cent. of such supply may be used for lighting. But the real question at issue is not whether a Corporation shall monopolise the supply of electrical energy—a mere local consideration—but whether the national industries shall be supplied with motive power at the lowest possible cost. It is a national, not a parochial, question. If the Corporation can beat the company in point of price, well and good; we should be the last to demur to its retaining its consumers under such conditions. But if energy can be obtained at lower rates than the municipality can offer, it is distinctly to the advantage of the community and the nation that the benefits of cheap power supply shall be realised to the utmost.

Another point raised was the supply of power to villages within the "sphere of influence" of a corporation. The demarcation of spheres of influence is well known to lead to bitter antagonism on the part of the respective claimants, and we deprecate its introduction into industrial affairs. As a matter of fact, the trouble is merely that when a certain Corporation had obtained powers to supply electricity to a number of villages which it regarded as within its sphere of influence, it was provided that "the consent of the Corporation should not be required in the event of a certain power company also wishing to supply these villages"! This naïve method of indefinitely extending the boundaries of a municipality, for trading purposes only, has thus been ruled out, and, in our opinion, rightly so. Mr. Wilmshurst denies that municipal engineers look upon power companies as their natural enemies, but he would limit their operations to consumers out of the reach of the

"Local Municipal or Company supply"—a proceeding which would naturally leave the power companies the mere plum stones, instead of the plums which they are said to seek.

The President dealt at some length with the position of the incandescent electric lamp, and, taking a leaf from the book of the gas suppliers, suggested either the free renewal or periodical inspection of consumers' lamps, with a view to ensuring high efficiency, good lighting, and corresponding satisfaction on the part of the consumer. That something of this kind is urgently needed we cordially agree. There is no doubt whatever that the great bulk of the consumers allow their lamps to remain in use long after their life should have been terminated, having a natural repugnance for destroying lamps which appear to them to be intact. The only way to overcome this tendency, which, in many cases, is wholly responsible for unsatisfactory results, is for the undertakers to take in hand the supply of lamps to consumers, as suggested by Mr. Wilmshurst. Any lamp which gives less than 80 per cent. of its normal candle-power ought to be destroyed, and replaced free of charge. The latter is an indispensable condition, for no other means of inducing the ordinary consumer to take action can be compared with the suggestion that he is getting something for nothing. We confidently believe that in most cases this would be verified, for the greater satisfaction and better lighting resulting would soon so increase the lamp connection that the costs of production would be reduced to a more than corresponding extent. We are pleased to note in this connection that Mr. Wilmshurst objects to municipalities undertaking wiring and interfering with the legitimate business of the local contractor.

Touching the heavy burden of capital charges, the President recognises power supply as an important aid towards their reduction (per unit), and urges low prices and motor-hiring as means of encouraging the demand. In Derby, although the supply is single-phase alternating current, the power connection has risen in five years from 70 KW. to no less than 1,300 KW. The excessive assessments of electricity works for rates and taxes also received attention; the whole question of assessment is undoubtedly in a chaotic condition, and urgently needs regularising. The astonishing variation of this item, from 0·02d. per unit sold to 0·7d. in different towns, alone suffices to indicate the lack of uniformity at present obtaining, and the need of reform.

Mr. Wilmshurst concludes with an appeal to the members to support the work of the Engineering Standards Committees, and to judiciously stifle "that natural desire for originality which smoulders in the breast of every well-regulated engineer." We are at one with him in this regard also, but we fear that the sacrifice he asks is too great to be realised.

THE ROYAL INDIAN ENGINEERING COLLEGE, COOPER'S HILL.

It seems scarcely credible that a Government which owes as much to engineering as does that led by Mr. Balfour should threaten, attack, and finally demolish the first engineering college of the Empire. When we say that the present Government owes much to engineering, we do not mean to imply any subtle signification to the word, for we believe absolutely in the genuineness of the motives which have prompted their action. But the fact remains that the Government which, alike in Egypt and in our Navy, has had greatness thrust upon it by progress in engineering, has deliberately turned aside to overthrow our premier engineering school. The fact becomes the more remarkable when we realise that it is the Secretary of State for India in Council who is immediately responsible for closing the Royal Indian Engineering College, at Cooper's Hill. For, surely, if there is any one part of the King's dominions more than another where engineering has wrought marvels, and where the engineering profession has claims to consideration, it is India, that mighty peninsula whose well-being and existence depends, so far as Great Britain is concerned, upon the maintenance of communications and irrigation. For many months the aim of a certain section of the Government has, for some inexplicable reason, been directed against Cooper's Hill. The India Office has now issued what we suppose is to be regarded as the final mandate on the question. According to the *Times* of June 23rd, the prospectus for 1904 states that the College will be permanently closed at the end of the session of 1905—1906, so that the entrance examination to be held in July of this year will be the last. From the candidates who pass this entrance examination, 25 appointments will be made in the Engineering branch of the Public Works Department, one appointment in the Accounts branch of this service, and two appointments in the Telegraph Department; and we are informed that a further communication will be made as to the future education of candidates for the Public Works and Telegraph Departments in India. This announcement sufficiently attests that there is no falling off in the number of specialised engineers required for the various branches of the Public Works Department in India, and we are therefore able to narrow down the issue to a question as to whether it is well to maintain a college for this specialisation, or whether the appointments should be open to competition amongst the engineering institutions of the empire. Our view is that while there are undoubtedly engineering institutions in this country capable of providing men of sound engineering education—men, for example, who have obtained engineering degrees at Cambridge, Glasgow, Dublin, Birmingham, men who have been awarded engineering diplomas at King's College, University College, or the Central Technical College, or men duly qualified upon the lines adopted by the Institution of Civil Engineers—they would all lack the specialisation necessary for India. Such men, provided they could pass the medical examination, and provided they could ride straight, shoot straight, and administer straight, might adequately carry out the engineering duties in India, but they would not be so efficient, and they would lack the stamp of men specialised at a college like Cooper's Hill.

Judging from a speech made by Mr. Brodrick at the anniversary meeting of the Royal Asiatic Society on May 11th, we should have thought that this view would have been shared by him, and that, instead of putting his hand to an instrument of demolition, he would have protested against anything that would tend to reduce the status of a Royal college intimately associated with India. He is reported to have said: "It is astonishing to those who have gone through a public school career to reflect on how little they knew, or had the opportunity of learning, at a public school in past days with regard either to India or our Colonies." We are inclined to regret that Mr. Brodrick, in his day, went through a public school career; but we are bound to admit the truth of his state-

ment, and we now ask him to accept the logical conclusion, that public schools and institutions do not impart that special knowledge of India, and that, *a fortiori*, public engineering colleges do not lay themselves out to meet the special requirements of Indian engineering. If they decide to do so, it means that the curricula of all our engineering colleges will be dislocated for the chance of 25 appointments; our engineering colleges would, in fact, specialise upon India with rather less justification than the Cavendish laboratory is now specialising upon air-pumps and electric discharges.

For example, it is, we believe, the custom in India to work out stresses, weights, and strains for telegraph line construction in agreement with the Indian wire-gauge. The Indian wire-gauge appears to be in India to stay; and it is well that it should stay *there*. It should not be allowed to take up the time of students at other than Indian engineering colleges. Nor, again, is there any good reason why the geology, or the physical geography of India, its architecture, its history, its languages, its fauna, or its flora, should be specially studied to the exclusion of knowledge of other countries where engineers may find appointments. In a word, in so far as specialisation interferes with the teaching of engineering in its broad sense, it is fatal to the interests of students as a whole. This is a principle which the Admiralty have adopted, and there is no reason why it should be rejected by the India Office. In a letter dated from the India Office, May 7th, 1901, Lord Hardwicke, as Under Secretary of State for India, wrote to the Chairman of the Board of Visitors to Cooper's Hill, as follows:—"Lord George Hamilton is inclined to believe that if the college is maintained, it will be possible, under the conditions now existing, to provide there a system of training which will be specially valuable and appropriate for students who look forward to an Indian career, *and which cannot be obtained in any institution or place of education wholly unconnected with India.*"

With this opinion we heartily agree. It appears to us, looking at the matter from a business point of view, that the affairs of the College have been muddled somewhere between the India Office and the Board of Visitors, and that the financial aspect of the situation has been sometimes lost sight of in the bringing about of so-called reforms, suggested by the Board of Visitors. As the College is admittedly larger than is required, and as the College grounds are certainly far larger than is necessary, it is curious that no suggestion is made to dispose of some of the land to equalise expenses. The original purchase price of the estate was £56,275, and the College could exist comfortably upon about half the area now covered. Leaving the cricket field intact, the farm, the vegetable garden, the President's garden, some pasture land, and much of the frontage at Englefield Green could be sold or leased without detriment. We are convinced that the financial objections are a myth, and we trust that engineers the world over will join with us in protest against the abolition of this noble and representative institution.

The Birthday Honours.

This year's list of Birthday Honours is not without its interest for the world of science and engineering. A baronetcy and three knighthoods, three C.B.'s and an appointment to the Imperial Service Order are those that call for comment in the Electrical Review. Mr. George White, who receives the very distinguished honour of a baronetcy of the United Kingdom, has had a very intimate connection with the commercial side of electric tramway traction, by reason of his connection with the Bristol Tramways Co., whose lines were equipped with the trolley in 1895, and also with the Imperial Tramways Co. and the London United Tramways Co. (1901). Prof. James Dewar, F.R.S., whose remarkable discoveries in chemical science are familiar to everybody, receives the well-merited, though tardy, distinction of knighthood; Mr. W. Lloyd Wise, the well-known expert in patent matters, receives a similar honour. The other recipient in the same section of the list is Mr. George S. Gibb, the up-to-date manager of the North-Eastern Railway, whose name has been very much to the fore in electrical circles recently, because of the electrification of the Newcastle sections of his company's lines, and because of his work as a member of the Royal Commission on London Locomotion. The following appointments have been made to the Most Honourable Order of the Bath (Civil Division):—

R. A. Egerton, secretary to the General Post Office, Dublin.

E. P. W. Bedford, secretary to the General Post Office, Edinburgh.

Lieut.-Col. H. A. Yorke, chief inspecting officer of railways under the Board of Trade.

To Lieut.-Col. Yorke during the last few years there has fallen a good deal of work in connection with electric railway systems, and he is a specialist in regard to the measures which are requisite for the safe equipment and working of tube lines.

We are pleased to note that the name of Mr. Arthur West Heaviside, one of the superintending engineers in the General Post Office, is down in the list for an appointment to be a Companion of the Imperial Service Order. Some of the leading points in Mr. Heaviside's career are referred to in "Our Personal Column" on another page to-day.

We believe that all of our readers will join with us in tendering hearty congratulations to all of the gentlemen we have named above upon the distinctions which his Majesty the King has conferred upon them.

Specific Heat of Superheated Steam.

In a paper presented by Mr. C. V. Kerr to the June meeting of the American Society of Mechanical Engineers, we find that Prof. Bach considers the specific heat of steam at 200 lbs. absolute pressure to be 0·6, and Mr. Kerr considers that other and later researches generally support the correctness of the assumption. The formula given in the paper is $c = 0{\cdot}48 + 0{\cdot}00065\ p$, when p is the gauge pressure.

Below atmospheric pressure, with Hirn's value of 0·43 at 32° F., and Regnault's value of 0·48 at 212° F., the equation for the specific heat between these limits becomes $0{\cdot}43 + 0{\cdot}00028\ (t - 32°)$ when t is the temperature F.

The diagrams drawn from two assumptions show a specific heat of about 0·625 for steam at 235 lbs. absolute pressure, and of 0·64 for steam at about 388° F., the latter value rising from 272° F. in a rather rapid curve, though below that point it is almost a straight line. The inference is that the specific heat increases with temperature whether the steam be superheated or saturated, but to what extent, if any, there are differences between the specific heat of steam in contact with water, and dry or superheated, is not attempted to be shown. It is just these things that need elucidation, and we hope the National Physical Laboratory experiments will solve most of the doubtful points with a fair approximation. Thus what difference will there be between the specific heat of steam at a temperature $x°$ and pressure p, and in contact with water, and that of steam at the temperature $x°$ and pressure $p - y$, not in contact with water, and, therefore, superheated?

ELECTRIC SIGNALLING ON RAILWAYS.

At the present time there are four methods in use for signalling on railways. The first, which is the one more generally adopted, is by means of the semaphore arm; this may be called the universal system for use in the daytime. In the second place, there is the method of adopting various coloured lights; this is generally used in connection with the semaphore arm, and is the method that is adopted for use during the night. For emergency purposes flags are used, while during foggy weather recourse must be had to explosive signals placed on the track, and operated by the wheels of the engine passing over them.

It will be noted that all these signals are used on the track, and not on the engine itself, and so far practice has shown that this is the best position in which to place the signals, as they can generally be seen by the signalman, and any defective working is at once apparent. The flagging system is only for occasional use. Leaving this method out of consideration, it may be stated that the method of using semaphore arms in the daytime, and coloured lights on the same posts as carry the semaphore arms during the night, gives every satisfaction, and that this system, combined with an interlocking of the various signals and points, ensures a high degree of safety.

It is a well-known fact that long-distance trains will maintain with this system an average speed, including stoppages, of 50 or more miles an hour, and will run into the terminal station punctually to time.

Let there be a fog, however, and the conditions are at once changed, although the fog may be of the slight character that is frequently known as a railway fog, by which is meant a fog that only affects railway work; now, instead of this high degree of excellency as regards punctuality, there is a general delay throughout the entire railway system; not only are the main line trains late, but the local traffic is entirely disorganised, and it is not at all unusual to find that an hour is taken to do a journey which customarily occupies 10 minutes only. If this is the result in connection with passenger traffic, it is easy to imagine what is the effect on the goods traffic; the trains are held up at all stations. So long as the railway companies rely upon signals placed along the track, and not upon the engine, this state of affairs must be maintained during foggy weather, for even their strongest adherent will not claim that the use of fog signals of the detonating class is conducive to high speed or to punctuality. Whether their use tends to ensure safety is also doubtful.

In order to improve the signalling arrangements without interfering with the existing semaphore system, but rather by adding a useful adjunct to it, which acts in conjunction with it in clear weather, and only supersedes it in foggy weather, Mr. Jan Voet, of Haarlem, has devised a means of repeating all signals on the engine. The method which he has adopted is simple, inexpensive, and free from any complicated parts. There is practically nothing to get out of order, while at the same time all the essential features that go to make the success of any signalling system have been kept well in view. Electricity plays a useful *rôle* in his system, but is so utilised that there can be no failure which would lead to an accident due to a stoppage in the supply or the breaking of any wire. The description of Mr. Voet's apparatus is as follows:—

Between the metals along which the train travels, he places a specially-formed piece of metal illustrated in fig. 1. It will be noted that this metal piece is formed at the top in the shape of a cross, but is so arranged that the two cross-arms do not spring from the same point in the upright, but one-half of the cross springs from the bottom, and is bent so that there is a clear space of some inches between the pillar and the top bends of this cross piece. In fig. 2 is shown the same piece of apparatus, with the arms rotated through a right angle. This piece of apparatus is connected to the wire or rod operating the semaphore arm of the ordinary signal as shown in fig. 5. The whole is so arranged that when the semaphore arm is against the train the cross-piece is set with the long arms at right angles to the direction of the rails, but when the semaphore is lowered so as to show a clear passage along the section, the same movement of the signal lever operates the cross-piece, and sets it with the long arms parallel to the rails. Thus, when the cross-piece has its long arms at right angles to the rails, this piece of the apparatus is in the danger position, and will indicate a stop signal to the driver on the engine. In the event of a connection between the semaphore signal and the

Fig. 1.

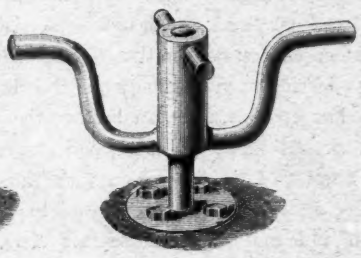

Fig. 2.

auxiliary signal breaking, or other accident occurring, the cross-piece will set itself automatically in the danger position, being thrown into this position by a spiral spring, clearly shown in fig. 6.

On some convenient part of the base of the engine or tender is fixed the apparatus shown in figs. 3 and 4. This consists of an electrical contact equipment of four copper spring pieces, shown in elevation in fig. 3, and in plan in fig. 4. In the latter figure one copper strip is removed, so that the method of attachment may be shown.

The method of working is as follows:—On the engine are mounted a couple of portable accumulators, and the circuit can only be closed through the two outer, or through the two inner, of the copper strips on the base of the engine. The

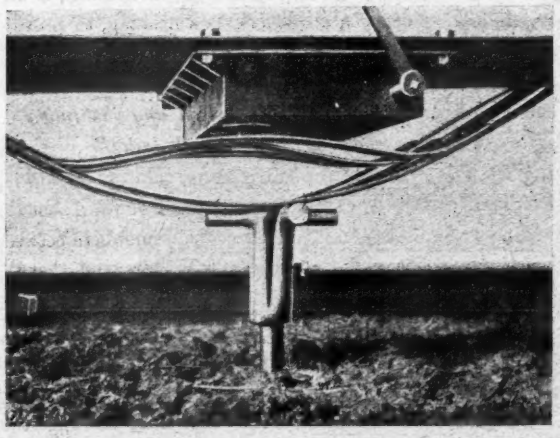

Fig. 3.

cross-piece already described is so arranged, that when this auxiliary signal is set in the danger position, the circuit is closed through the two outer strips only, the distance between the inner bends of the longer cross-arms and the pillar being sufficient to allow of the inner strips clearing them. In the event of the signal being set in the open position, the circuit is completed through the two inner strips, the shorter cross-arms being made sufficiently short to permit of the outer strips passing clear.

It will be noted that in either case a circuit is closed, so that an indication will be given on the engine of the position of the signal, whether up or down. This constitutes its great difference from the detonating signal for foggy weather, which only indicates when the section is closed, and not when it is open. On the engine are mounted two electric bells and two sets of lamps, one a green set and the other a red set. Immediately the circuit is closed through the contact

strips, one bell rings continuously, and at the same time one set of lamps becomes incandescent; if the signal is open the green lamps glow, if the signal is at danger the red lamps glow. These lamps can be arranged in parallel for extra safety, and, if necessary, a green or red disc can be shown on the head lamp lights. The lamps continue to glow and the bell to ring, until the engine driver has moved a lever which interrupts the circuit, the arrangement being

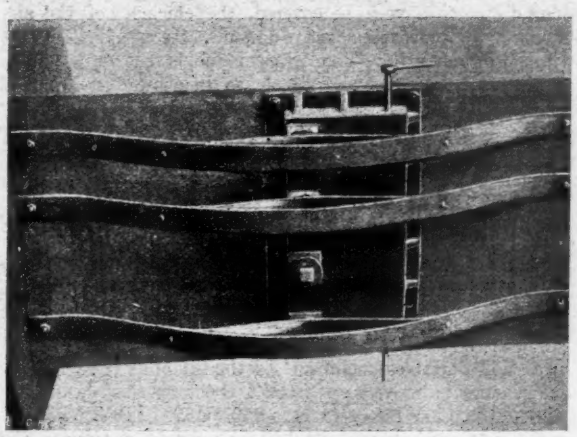

Fig. 4.

similar to that adopted in what are known as continuous ringing bells. In fig. 3 the copper strips are shown making contact through the outer set, the signal being set for the danger position. Fig. 5 represents an engine passing over a clear signal, and shows the relative position of the auxiliary and main semaphore signal. This figure also shows the arrangement of the bells and lamps on the engine. A further piece of apparatus is included in the patent specification, and consists of an indicator not under the control of the driver, which shows how many signals have been crossed in the clear position, and how many signals in any journey were set against the train.

Mr. Jan Voet claims that this invention of his fulfils all the requirements of any signalling apparatus, and even under

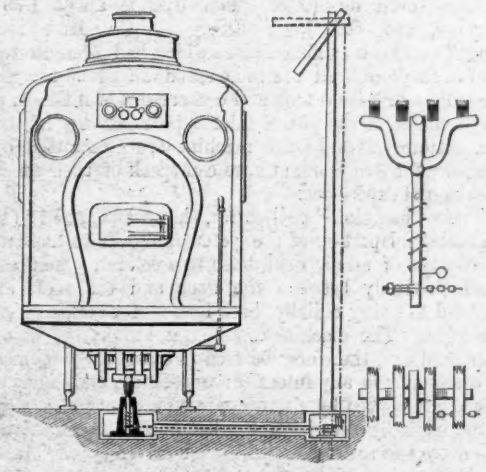

Fig. 5. Fig. 6.

ordinary working conditions is a valuable auxiliary to the existing semaphore signals, while in foggy weather it is an essential appliance, if punctual running, combined with safety, is desired.

It will be noted that electricity plays an important *rôle* in this design, but that there is no chance of anything going wrong through its use; should the connection between the signals break, it has been shown that the auxiliary signal will automatically set itself in the danger position and the train will simply be brought to a standstill, as is the case should the semaphore signal break down as at present arranged. The inventor claims that by the use of primary or secondary cells in place of generating a current on the engine by a dynamo, a greater degree of safety is ensured. Again, the fact that all the signals are indicated on the engine, and not the danger signals only, secures a still greater amount of safety. The driver knows where his signals are, and also knows that each must be repeated on the engine; if then he runs past a signal without any indication being made on the engine, he knows at once that something is out of order, and immediate attention can be given. There have been cases where accidents have occurred which are alleged to be due to the driver overrunning his signals through colour blindness; this is prevented in this system, first, by the positions of the red and green incandescent lamps on the engine being different, and, secondly, by the ringing of two differently toned bells, one for danger and one for safety. Further, it is well known that the signals must be set so that the driver can, in the majority of cases, see them long before he reaches them, but in this system the auxiliary signals can be set at any desired distance in front of the semaphore signals; when the line is carried through a cutting round a curve, it is difficult to find a perfectly satisfactory position for the semaphore signal, but with this new system the difficulty disappears.

Mr. Jan Voet claims that the cost of applying this auxiliary system would be small, and little extra running expense would be incurred. It is not suggested that the system is free from objections from the point of view of railway men; but it will be admitted that any device which shows a good prospect of reducing delay within reasonable limits, if combined with safety, deserves consideration, especially if, as in the present instance, the apparatus is inexpensive, and at the same time does not supersede existing methods of working, but is intended to supplement them.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Carbon v. Copper Brushes.

I was much interested in the article by Mr. Burleigh in your issue of the 10th, on the use of carbon brushes, with comparative figures relating to carbon and copper brushes in the case of a six-pole machine of 110 volts and 800 amperes. In spite of the very large extent to which carbon has replaced copper for brushes of late years, the writer anticipates the abandonment of carbon in a comparatively short time.

His figures certainly would support his argument, but it would appear that he has not followed the recent developments in carbon brushes, for his figures relating to them, though fairly representative of existing practice, differ considerably from what might be if dynamo design had had time to take advantage of the improvements in recent types of carbon brushes.

For instance, the number of amperes per square inch of contact is given for carbon as 26·4 and copper 90·3.

Now, it is a fact that there are carbon brushes which may be run at the same figure as that given for copper, without losing any of the characteristics which give the special value to the use of carbon.

Makers of machines are naturally very cautious in altering their designs without examining very closely the claims with regard to improved carbon brushes, but I know that one maker at least is making an exhaustive trial of those of more modern type, with a view to seeing what can be safely done in regard to the redesigning of his commutators.

There are several qualities in a carbon brush which combine to produce sparkless collection with the minimum of friction. High specific resistance is by no means the only essential, and the amount of this which is necessary is often over-stated. The difficulty in the matter is that nothing but actual trial is of any practical use in deciding the good qualities of a carbon brush, though the bad qualities of some are not difficult to recognise.

An instance came under my notice recently of a motor on

which some high-class brushes, supplied by the makers of the machine, were replaced by others sent by me for trial. The tension of the springs had been adjusted to the non-sparking point with the old brushes, but the commutator always heated seriously at full load. With the new brushes the tension could be relaxed to a considerable extent with perfect sparklessness; the commutator now runs perfectly cool, and a difference has been found of 300 watts in the power taken on no load.

Mr. Burleigh would have obtained very different figures for his comparative tables if he had taken those for carbon from the second of the two sets mentioned above. I am not writing in order to puff any particular carbon brush. From the point of view of the user, he naturally uses the cheapest carbons which will keep his commutator in order and give no trouble, but it often happens that in effecting a little saving in his carbons there is a loss of economy on the machine as a whole.

So far from anticipating the abandonment of carbon brushes in the near future, I would venture the prophecy that the improvements in the modern carbon brush will lead to a sensible reduction in the sizes of commutators for carbon brushes, and entirely alter the figures of commercial efficiency given by Mr. Burleigh. Every carbon brush should bear a distinctive mark whereby its origin and grade may be recognised, and uniformity of quality in manufacture is imperative, otherwise machine makers can never feel that confidence in the brushes which alone would justify them in making radical alterations in design.

The very nature of carbon manufacture in the past has rendered the above conditions commercially impossible. Another most important factor in the present state of the trade is that good carbon brushes must be reasonably cheap, or else so-called "cheap carbons" will present too potent an attraction to users.

W. Stepney Rawson.

25, Victoria Street, S.W.
June 25th, 1904.

THE COLLIERY EXHIBITION.

We have heard so much about the backwardness of the colliery owners of this country in adopting the up-to-date methods which we are led to believe are almost universal on the Continent and in America, that the question naturally arises as to whether or not our national modesty is not, as usual, causing us to magnify alike our own shortcomings and the progressiveness of our foreign competitors in the world's markets.

A visit to the Colliery Exhibition at the Agricultural Hall, Islington—which, we may remind readers, closes to-morrow—should go far towards dispelling the idea that the backwardness, if backwardness exist, is due to any unpreparedness of our manufacturers to supply the necessary machinery and apparatus for any mining operations whatsoever.

The chief purposes to which machinery may be applied in collieries are pumping, hauling, coal-cutting, ventilating and winding, and machines for all these purposes, driven either by steam, compressed air or electricity, are on view.

Electrical engineers are, of course, most interested in the applications of electricity to the driving of such machinery, and it is not claiming too much to say that electricity can be, and has been, successfully applied to all the above processes; in fact, a prominent feature of the present exhibition is the large display of electrical plant and power equipments.

That power can be transmitted to a distance, and distributed more economically, by electricity than by any other known means, including steam, compressed air or wire ropes, is now pretty generally admitted and appreciated; and the cheap supply of electricity from public companies ought to do much to stimulate the use of electrical methods of driving in colliery work, where, perhaps, the initial cost of establishing generating stations on site has been a factor in checking development.

It is interesting and encouraging to note that electrical manufacturers are taking up the manufacture of mining machinery driven by compressed air, because, whilst, as a transmitting medium, electricity cannot be surpassed, it does not necessarily follow that we must take it right up to the coal face if compressed air is for some purposes more convenient or more advantageous.

Compressed air coal-cutters are preferred by many colliery managers, to electrically-driven ones, because they are considered safer and require less skilful handling. But, when long distances have to be covered, the efficiency of the air system is low and extensions are difficult. Here, then, is where electricity steps in. The transmission is economical and extensions are exceedingly simple, so the compressors can be driven electrically, and gradually moved forward as the work advances, keeping the air pipes down to, say, 300 yds. or so in length.

This is a system that has been adopted with marked success in places where short faces only are worked, and where, in consequence, electrically-driven cutters are not very suitable, on account of their size and weight. This method of working is carried out in one of the Northern collieries, where there are about 14 percussion machines in use of the Ingersoll-Sergeant type. This machine is shown at the stand of the Ingersoll-Sergeant Drill Co., and is a very compact and portable machine. As the headings advance the compressor is moved up so that the maximum length of air transmission rarely exceeds 250 yds. This machine is really a punch or percussive drill mounted on a trolley. It has no rotary motion at all, but works simply on the pick principle, and can be easily handled by two men. For short work and headings these machines appear to be very successful, one machine being capable of working three headings 12 ft. wide × 4 ft. 6 in. undercut, in a shift of eight hours. This is not an exhibition record, but an actual record of everyday work. The weight of the machine is about 5 cwt., and occupies a very small space. It delivers 160 strokes per minute, the full length of stroke being 18 in. All joints are metal to metal, the only packing being that on the pick shaft, which is an ordinary cup leather. A special feature of this machine is the air buffer for taking up the shock in the event of the tool missing the core. The maximum for soft stuff is 26 yds. per shift, and 18½ for hard work, the undercutting being 4 ft. 6 in. in each case. Each machine takes about 75 cb. ft. of air per minute, and in the case mentioned above, one compressor supplies seven machines. The cost is about £75 per machine, and the Ingersoll-Sergeant Co. have recently bought two back at £25 a piece which had been in regular use for 12 years. At the same stand are to be found compressed air drills and tools and compressors of different types. The machine of the piston inlet type is shown in section. The piston valves in this machine are guaranteed by the company for five years, and we can speak of their excellence from actual experience.

The "Champion" coal cutter, shown at Stand 19 (Bay's) is another adaptation of the percussion drill to coal cutting. It consists of an air drill fixed to a column which can be fixed vertically between the floor and the roof, and is adapted to swing radially, both in a vertical and a horizontal direction. The machine can be set at any height on the port, and can, therefore, be used to cut at the top or bottom of a seam, or in any intermediate position, and at any angle. Although worked by air, there is no inherent reason against actuating it by electric motor, but electrical percussive drills are not yet so satisfactory as the air-driven type. The stroke is shorter, they are heavier and more expensive.

This machine, like others of its type, is best suited for driving headings, and for pillar and stall work, and by using extension rods, can cut to a depth of 7 ft. The best record for this machine in England was made at the Aldridge colliery, near Walsall, where 330 sq. ft. were cut in 440 minutes. In three days, 410 sq. ft. were cut in 20 hours; this really means in three shifts of eight hours, which would work out to about 38 sq. ft. per hour.

In Pennsylvania, U.S.A., a better record has been obtained, but this is no criterion for this country, as it is admitted that the seams there are thicker and easier to work than here, which largely accounts for the increased output per man, with or without coal-cutting machines.

A machine is fitted up at this stand in a room designed to

represent a coal heading, so the method of operation under normal conditions is imitated as closely as possible.

A miniature model is also shown in actual operation cutting a block of real coal.

Coming under the same category is the "Hardy" machine, shown at the stand of the Hardy Patent Pick Co, Ltd., No. 38. This is essentially a "Hardy" air drill mounted on a pillar in a somewhat similar manner to the "Champion."

The method of manipulation, as regards swinging the drill, is different, this being done by hand instead of by a hand-wheel and gear. It is said to be the lightest coal-cutter on the market, the machine itself weighing 140 lbs., and it is further claimed that it is capable of cutting, on the average, 20 sq. ft. per hour in coal or dirt, holeing or undercutting. The same company show a number of mining tools and apparatus of general interest, including picks, pit prop withdrawer, the "Devil" disintegrator, the "Vibromotor" screen, and a small model of the "Elliott" coal-washer.

The Diamond Coal-Cutter Co. has a very good collection of coal-cutters, although it was difficult to get much detailed information as to the working of the machines. This company has supplied some 400 machines during the last four years, including both air and electrically-driven machines. These machines are of the disc cutter type, and are specially adapted for thin seams, and can be supplied to undercut from 4 ft. 6 in. to 7 ft. The record for the air-driven machine is 523 yds. in 16 hours' bank to bank undercutting 5 ft. 6 in.; for an 8 hours' shift 273 yds. is the record, but these are test records on long walls, and not working averages. The year's averages vary from 60 to 80 yds. per shift. The electrically-driven machines are made in two types, namely, the single and double-motor type, the former being specially adapted for short work. In the double-motor type there is the advantage that in continuous-current work the full pressure is not carried on each machine, and as the motors are each of about 12 H.P. instead of 25 for a single motor, the head room is somewhat reduced, and the weight is, of course, better distributed over the machine. The total height of these machines can be got within 19 in., and the air-driven machines within 18 in. For equal outputs the comparison between the electrically-driven and air machines works out approximately as follows:—

Air-driven machine, approximate 27 cwt., price £250.

Electrical machine with two motors, weight about 37 cwt., price £420.

The machine was also shown equipped with two three-phase motors, which were both operated by means of one starting handle.

(To be continued.)

THE MUNICIPAL ELECTRICAL CONVENTION.

The ninth annual convention of the Incorporated Municipal Electrical Association was opened on Wednesday at Derby. The weather conditions were ideal, being in strong contrast to those which prevailed at last year's meeting. The large gathering of members and friends was welcomed at the Technical College by the Mayor, Mr. Cornelius Boam, who, in the course of his speech, referred to the honour done to Mr. Wilmshurst and the town of Derby in electing their chief electrical engineer as president of the Association. He gave full credit to Mr. Wilmshurst for the very favourable progress that Derby was making in electrical matters, and trusted that the M.E.A. would continue to flourish and prosper. In these remarks the Mayor was seconded by Alderman Butterworth, the chairman of the Electricity Committee. Though it was true that Derby was able to hold out but few chances of visiting large engineering establishments, he had had an offer for the Association to visit one of the largest breweries in the country; he himself was inclined to favour the suggestion, but Mr. Wilmshurst, who was better acquainted with the members, counselled discretion.

Mr. Wilmshurst having briefly returned thanks on behalf of the meeting, proceeded to read his presidential address, which dealt largely with the present commercial conditions affecting the electricity supply business, and to which we refer in some detail in our leading columns this week. Thanks were accorded to the President on the motion of Dr. Panton.

Mr. C. E. C. Shawfield, the city electrical engineer of Wolverhampton, then read his paper on "The Commercial Practicability of Electric Traction by Surface Contacts." He illustrated his remarks by an excellent series of lantern slides, among them being some very gloomy pictures of Manchester overhead networks, which were shown for the purpose of contrast. The paper was adversely criticised at some length by Mr. J. H. Rider, the chief electrical engineer of the London County Council tramways, and others. Mr. A. P. Cridge, of Sheffield, followed with his paper on "The Organisation and Management of a Central Station Meter Department," but this evoked but little comment.

The proceedings were resumed at Nottingham yesterday, and to-day Sheffield is the place of meeting. On Saturday the Association returns to Derby to discuss business matters.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"H. B. B." writes:—"Corporations and electric supply companies who issue wiring rules give an insulation test below which they state they will not connect the supply. This minimum in different rules varies considerably. I give two extreme cases. The insulation resistance to earth shall not be less than (in the first case) 10 megohms divided by the current and (in the second case) in megohms, the number obtained by dividing the pressure of supply by the number of lamps.

"Now, what is the legal position; can the undertakers make what rules they wish as to the insulation test; or has the Board of Trade laid down a minimum, and if so, can the consumer demand to be connected if his installation pass that minimum?"

*** The Board of Trade Regulations on the subject of insulation do not seem to prescribe any particular form of test. Clause 39 of the regulations provides that:—"All electric lines and apparatus placed on a consumer's premises shall be highly insulated and thoroughly protected against injury to the insulation or access of moisture, and any metal forming part of the electric circuit shall not unless efficiently connected with earth, be exposed, so that it can be touched. All electric lines shall be so fixed and protected as to prevent the possibility of electrical discharge to any adjacent metallic substance."

It is conceived that under this regulation, undertakers may make what rule they please with regard to insulation tests. In any event there is no express provision which would enable the rule made by the undertakers to be called in question, unless, indeed, their requirements were shown to be so unreasonable as to interfere with the lawful demand of a consumer to be supplied with energy.

LEGAL.

Commission Claim.

In the City of London Court, on Friday, before his Honour Judge Rentoul, K.C., an action was brought by Mr. Henry Cohen, commercial traveller, residing at Canonbury, to recover the sum of £5 18s. 1d., commission due on the sale of electrical goods from the defendants, the Union Electrical Co., Ltd., 151, Queen Victoria Street, E.C. It appeared, according to the plaintiff's case, that the defendant agreed to give the plaintiff 10 per cent. commission for the sale of a motor-car on their behalf. He introduced the matter to Messrs. Watson & Co., who did not buy the motor-car, but who afterwards bought electrical goods to the amount of £118. The plaintiff now claimed his commission of 5 per cent. on the electrical goods, contending that he was entitled to commission on any goods which were sold to Messrs. Watson & Co., although he had not been actually instrumental in selling the goods.

Mr. Kayes, for the defendant company, said they had never agreed to give the plaintiff any commission for selling the electrical goods. The mere fact that the plaintiff had introduced Messrs. Watson & Co. to the defendants did not justify the plaintiff in being paid a commission on the goods which Messrs. Watson & Co. had purchased.

Mr. Watson, in giving evidence, said he had known the defendants for a long time by reputation, and he had corresponded with

them about the motor-car through the plaintiff, after that transaction fell through. Later on he bought some arc lamps. He knew there was a new lamp that had been brought out by the defendant company, but he had not seen it. It was a little different from the ordinary arc lamp, because it was a different coloured light, and it was what he had been looking for. He happened to tell the plaintiff that he wanted a lamp of that description, and the plaintiff then said he could see one if he went to the Show at the Agricultural Hall. As a matter of fact, he went to the Agricultural Hall and saw the lamp on show, and the working parts were explained to him. As a result he bought of the defendants £118 worth of arc lamps. He would not have bought them if they had not been satisfactory, nor would he have gone but for the introduction of the plaintiff. If the plaintiff had never introduced the lamp to him he believed he would have bought it, as the lamp had since become much better known, and in that way it would have come to his ears.

Mr. KAYES argued that the plaintiff could not recover commission under the circumstances.

Judge RENTOUL: If a firm agree to give commission for one specific business, is that man entitled to commission on everything else that comes along through that introduction? The point is certainly a very interesting one.

Mr. KAYES: Three months elapsed between the two transactions. We are not bound for ever, surely, to pay him a commission on everything that Messrs. Watson buy. If the Court finds for the plaintiff we shall certainly have to do so.

Judge RENTOUL said not after notice had been given. The plaintiff was a commercial traveller, and it was his work to get commission on introductions he effected. The agreement was not very clear; it was a case for a compromise. The defendants would never have heard of Messrs. Watson but for the plaintiff's introduction. Having regard to all the circumstances, he would find for the plaintiff for £3 and costs.

SALVAGE SERVICES BY A CABLE-SHIP.

IN the Admiralty Court on Monday, before Mr. Justice Barnes, the owners, master, and crew of the cable ship *John Pender*, belonging to the Eastern Telegraph Co., applied for the apportionment of a sum of £200 which the owners of the ss. *Dordogne*, of Marseilles, had agreed to pay for salvage services rendered. It appeared that in the course of a voyage from Colombo to Marseilles with a cargo, a fire broke out on the *Dordogne* in December last, and the *John Pender* coming up, she was requested to stand by until the fire had been put out. The operation took 5½ hours, and the fire having been extinguished, the *John Pender* proceeded on her way.

Mr. STEWART MOORE, who appeared in support of the application, said that the point was that the *John Pender* was an extremely valuable ship, being worth £200,000. She had a crew of 88 hands, and they did practically nothing but stand by for 5½ hours.

His LORDSHIP awarded £150 to the owners of the *John Pender*, £20 to the captain, and £30 to the crew.

A WOOD-PAVING CONTRACT.

IN the Commercial Court of the High Court of Justice on June 23rd, the case of the Acme Flooring and Pavement Co., Ltd., *v.* Osman came before Mr. Justice Channell. Mr. Hamilton, K.C., and Mr. Wallace appeared for the plaintiffs, and Mr. Morton Smith for the defendant.

Mr. HAMILTON said the plaintiffs carried on a large business in supplying wood blocks for street paving. The defendant, Mr. Frederick Osman, was a contractor for paving, and he entered into a contract with the Corporation of West Ham for paving certain roads in which there were electrical trams. There were two contracts. One was called the permanent way contract which was for the part of the road between the rails, and the other was for the part of the road from the kerb to each side of the rails, and that was called the paving contract. It was in connection with this contract that the present dispute arose. Having heard that Mr. Osman had obtained the paving contract, the Acme Wood Co. approached him for the purpose of supplying him with wood blocks and laying them. The matter was dealt with by correspondence, and eventually when a price had been agreed, a contract was concluded by which the plaintiffs were to supply and lay wood blocks. The plaintiffs had done the work, and they now claimed their full payment. The defence was that on the terms of the letters, there was incorporated into plaintiffs' contract all the conditions of defendant's contract with the Corporation, and particularly the condition that, whereas he was subject to a reduction clause, he was only entitled to 80 per cent. of the payment until some six months had elapsed from the completion of the whole work. Therefore, defendant contended that the plaintiffs were subject to a like reduction.

Mr. MORTON SMITH said that in the contract there was a clause for maintenance and also for the measuring up of certain parts to be paid for when the amount was ascertained, and a certificate had been obtained from the surveyor. That certificate had not been ascertained, and the question was whether the plaintiffs were bound by that.

After reading the correspondence,

His LORDSHIP gave judgement for the defendant on the issue as to the construction of the contract, with the costs of the argument.

PARLIAMENTARY.

ELECTRIC LIGHTING (LONDON) BILL.

THE Board of Trade Bill for the adjustment of the areas within which local authorities and companies are authorised to supply electricity, was considered by Mr. Bousfield's Select Committee of the House of Commons on Wednesday, June 22nd.

The preamble of the Bill states that "Whereas it is expedient to make the boundaries of the areas within which the Council of any metropolitan borough in London is authorised to supply electricity, co-terminus, as far as may be, with the boundaries of the borough, and for that purpose to affect in certain cases the boundaries of the areas of supply of companies authorised to supply electricity, and whereas it is expedient to provide for agreements being made as between companies authorised to supply electricity for the purpose of making their areas of supply co-terminus, &c, therefore . . . (1) Where, by reason of any alteration of boundary under the London Government Act, 1899, any area, being part of the area of supply of the council of a metropolitan borough, has become situate outside the borough, that area shall (except as provided by this Act) be transferred to and become part of the area of supply of the council of the borough in which the transferred area has become situated if that council are authorised to supply electricity within the borough, or if that council are not so authorised, of any company so authorised, but only if the area of supply of that council or company adjoins the transferred area; (2) Where, by reason of any alteration of boundary under the London Government Act, 1899, any area, being part of the area of supply of a company authorised to supply electricity, or being an area in which no authority or company are authorised to supply electricity, has become situate within a borough in which the council of the borough are authorised to supply electricity, that area shall (except as provided by this Act) be transferred to and become part of the area of supply of that council adjoining the transferred area. Provided that this section shall not apply in the case of an area being part of the area of supply of a company; (*a*) where the area consists of or comprises a whole parish or the greater part of a parish; or (*b*) where the company are authorised to supply within the borough in which the area has become situate, at any point adjoining the area.

The preamble proceeded to state that the foregoing provisions were not to apply in the case of any parts of an area of supply in which mains or other works for the supply of electricity had been laid down or executed before January 1st, 1904. The Board of Trade took power to confirm agreements with regard to the transfers. They also wished to be able to postpone agreements if they considered such a course necessary, and to determine any questions arising under the Act.

Petitions against the Bill were lodged by the Borough Councils of Battersea, Bermondsey, Islington, and Southwark, and the County of London Electric Lighting Co. also petitioned.

Mr. CLAUDE SCHUSTER opened the case for the promoters. He said that the Bill was introduced to remedy some inconveniencies which had arisen in consequence of orders made under the London Government Act, 1899, which altered the mutual course of affairs. The state of affairs was this. Under the London Government Act there were scheduled a number of parishes, areas, and district boards, which were to be made into boroughs, and the Commissioners who prepared the orders made a number of alterations all round the boundaries of the boroughs. (Maps were submitted showing the alterations.) Those alterations took effect for all purposes of local government, but they did not automatically take effect for the purposes of the Electric Lighting Acts. At the time of the passing of the Act of 1899 the state of affairs, so far as electric lighting in London was concerned, was this: All London, with one very small exception, had been entirely mapped out into electric lighting areas. Some of these were areas of companies and some of local authorities. With two exceptions there was no competing order between a company and a local authority, but there were many cases where two companies were authorised to supply in competition. The areas mapped out by provisional orders as electricity areas were in all cases so marked as to be constituted the local areas as they then existed. The consequence was that when the orders with regard to the new boroughs came into operation the new boroughs did not coincide at all with the old electric lighting areas. Dealing with specific cases, he referred to St. Pancras. St. Pancras, he said, was a local authority which had electric lighting powers. The Council was now supplying electricity, or had a right to supply, to consumers outside the borough area, whereas various companies and local authorities round the edges of St. Pancras had power to supply with the borough. That state of affairs was very inconvenient when they came to look to the future. Under the Electric Lighting Act of 1888, at a certain time, not longer than 42 years, any local authority had power to purchase the undertaking of the company situated within its area. All London orders had been so drawn, and the powers accrued on the same date, 1931. When 1931 came along St. Pancras would be in a very inconvenient position; in fact, so would all the authorities who desired to purchase. In the case of Southwark, for instance, which had not powers over its whole area, the position would be that they would not be purchasing necessarily from the same company, and instead of purchasing one whole, or one considerable part of a whole, they would have to purchase from and bargain with an enormous number of different people. That was what would happen in the future. So far as the present was concerned, the inconveniences were considerably greater. As the Committee were aware, there were numerous cases in

the country of local authorities which supplied electricity outside their own area under provisional orders. At the time when the provisional orders were made, nobody anticipated that it would be possible to have such a thing as a London vestry supplying outside its own area; and consequently the provisions were not put in. So far as St. Pancras was concerned, the Borough Council was not under any statutory obligation to give notices, nor were the other boroughs obliged to give notice to St. Pancras, and that was, obviously, inconvenient. The obvious principle at the root of the Bill of 1899 was: that as far as desirable, the boroughs should be self-contained areas, and that so far as they were authorities having power to supply electricity, those powers should be within the area, and not extend beyond it. The London Government Act Commissioners were in rather a difficulty. They had power under the Act to adjust the boundaries for electric lighting purposes, so far as two contiguous parties were local authorities. There was power to make schemes which were subject to the Municipal Corporations Act, and by those schemes they might have adjusted matters, but it was extremely doubtful whether their powers extended to touch the rights of companies. The operation of those powers was stayed, and ultimately it was agreed that the Board of Trade should take the matter in hand and endeavour to bring about a settlement between the companies as the authorities concerned. Counsel then went into a history of the Bills introduced by the Board of Trade. If the present Bill was passed, it would mean that when a local authority's undertaking bordered upon the area of another undertaker, the boundary would follow the line of the boundary of the borough, but not if the company or the authority from whom the transfer would have been made had executed works. That was the difference between the present Bill and the Bills of 1902 and 1903, and the original Bill of 1901. Considerable discussion between counsel followed Mr. Schuster's speech.

The Hon. T. H. W. PELHAM (assistant secretary to the Board of Trade) was then called. He stated, in the course of examination by Mr. Schuster, that he had had a number of conferences with representatives of local authorities and companies as to the principle upon which the Bill should be prepared. They came to the conclusion, at first, that it would be desirable to make the transfers compulsory in all cases, but to reserve power to the Board of Trade to defer the transfer until the local authority had been able to make connections with the mains in the area transferred. Afterwards, as it was evident that there was so much opposition, the Bill was altered so as to apply to unoccupied area only. There were now 14 local authorities supplying electricity in London.

Mr. SCHUSTER: And three of these appear on the question of compulsion?—Yes.

Mr. SCHUSTER: So that the others seem to be satisfied.

Cross-examined by Mr. CLEASE (for Bermondsey), he admitted that the Borough Council would lose certain portions of their area, but from an electrical point of view, he considered them worth nothing. Mr. Clease, in course of further cross-examination, said that the difficulty in Bermondsey was that the companies would not agree to transfer their works, and secondly, that the Borough Council were not willing to take over the works as provided by the Bill. Witness was cross-examined by Mr. Vesey Knox (for Southwark) and by Mr. Dewey (for Islington).

At the conclusion of the cross-examination, the CHAIRMAN asked the witness if there would be any objection to scheduling certain areas, and saying, "Notwithstanding anything in this Bill, such and such a thing shall not be done with such and such an area." Witness considered that it would encourage a great many local authorities to petition the next House to get the same principle applied to them.

On the question of the unoccupied areas, the CHAIRMAN suggested that the clause should read, "Where there is an unoccupied area in any borough which the borough is not authorised to supply, and which adjoins an area which the borough is authorised to supply, such area should be transferred to the borough." WITNESS: I do not understand that that would transfer it from the company?

The CHAIRMAN said that he was limiting it to boroughs. WITNESS said that that was what they wanted in the Bill, but there were all sorts of exceptions to be guarded against. It was a most complicated subject.

On Thursday, June 23rd, Mr. CLEASE addressed the Committee on behalf of Bermondsey. He contended that in the case of Bermondsey there should be exceptional treatment. They would lose portions over which they had powers at present, and would gain portions over which they would have no right to supply. The County of London Co. was the only company supplying in the district. There was another company, but it had done nothing at present.

Mr. FREDERICK RYALL was called on behalf of Bermondsey, and described what had been done in regard to electric lighting in the borough.

Mr. VESEY KNOX (for Southwark) said that the position of that borough had been greatly complicated owing to the fact that in the early stages of electric lighting the Board of Trade gave powers to the London Electric Supply Corporation, who had, in fact, given a very small supply in isolated places only within the large area for which they had powers. The Committee would see that they had powers over the whole of their area, and that had complicated the matter. Southwark supplied the southern part of the borough itself. St. Mary, Newington, the part he referred to, had a parochial undertaking before the passing of the London Government Act. Under the London Government Act there was a financial adjustment, and the undertaking became a borough undertaking. Continuing, counsel said that they did not seek anything that would injure any existing company which was already supplying electricity within the area; but what they did say was that when there was an area which was not supplied by a company, and which could conveniently be supplied by them, they should have power to supply that area. Counsel then went at great length into the details of his case.

The CHAIRMAN suggested that Clause 3 of the Bill should read:—"The foregoing provisions of this Act as to transfer of parts of areas of supply shall not apply in the case of any part of an area of supply in which mains (other than mains along a boundary road) or other works suitable to, and used for, the supply of electricity, had been laid down." If the only thing was a main along a boundary road, then it would be treated as an unoccupied area. He thought that would meet Mr. Vesey Knox.

Mr. Vesey Knox called the borough engineer, Mr. ARTHUR HARRISON, who described the arrangement of the mains, &c., in the borough.

The Chairman intimated that he wished to ask Mr. Pelham a question. In reply to the chairman, Mr. PELHAM said that the Board of Trade agreed with Mr. Schuster's view, that, under the Bill, the detached area, marked 6 in the petitioner's plan of Southwark, would remain part of the supply area of Bermondsey, and would not go to the company.

After further discussion, the preamble of the Bill was declared proved, subject to certain amendments, one of which was that Paragraph C of Sub-Section 1 of Section 4 should read: "Any agreements for the transfer of an area for the purposes of furthering the objects of this Act." In the case of Bermondsey, the Committee could not see their way to alter the principle of the Bill.

MUNICIPAL UNDERTAKINGS AND THE BERMONDSEY CLAUSE.

ON Tuesday the Select Committee of the House of Lords, under the chairmanship of the Duke of Northumberland, resumed consideration of the various opposed electric lighting orders in Confirmation Bills 3, 4 and 6. The Committee at the previous sitting found the preambles of the Bills proved, but left over the question of clauses for argument.

Mr. VESEY KNOX, who appeared on behalf of the Maidenhead Corporation, submitted the following clauses for insertion in the Bill, in order to carry out the previous decision of the Committee:—

1. The undertakers shall so soon as the annual statement of accounts of the undertakings under this order and under the Maidenhead Electric Lighting Order, 1898, has been filled up in the form prescribed by the Board of Trade under the Electric Lighting Act, 1882, publish in a newspaper circulating in the borough a notification that such statement of accounts has been filled up and that copies of it can be obtained at the offices of the undertakers at a price not exceeding 1s. a copy, and such publication shall be in addition to and not in substitution for any publication prescribed by the Board of Trade under the Electric Lighting Act, 1882.

2. The undertakers shall on the expiration of the third complete financial year after they have commenced to supply electrical energy under this order and on the expiration of each third succeeding year reconsider, and, if necessary, revise so far as is reasonably practicable, the scales of prices charged for electrical energy under this order and under the Maidenhead Electric Lighting Order, 1898, respectively so that in the judgement of the undertakers no rate will be required for the purpose of defraying the future expenses of the said undertakings during the next three years: Provided, nevertheless, that—

(*a*) The prices to be charged shall not exceed the maximum prices which may be charged under this order and the Maidenhead Electric Lighting Order, 1898, respectively;

(*b*) The scales of prices so reconsidered and revised may be from time to time in like manner reconsidered and revised by the undertakers.

3. Nothing in this section contained shall prevent the undertakers from entering into contracts for periods which may extend beyond the periods at which any revision may take place under the provisions of this section on special terms under special circumstances not applicable to ordinary consumers, but save with the consent of the Board of Trade each such contract shall provide that the price to be charged for energy supplied under such contract shall either

(*a*) Be subject to revision at the next triennial revision provided for in this section, or

(*b*) Vary in the same proportion as the prices charged to ordinary consumers, Provided that the undertakers shall not, without their consent, be required to accept any price lower than the minimum price mentioned in such contract.

With regard to Clause 1, as a matter of fact, the Board of Trade presented the form of accounts, but did not prescribe the form of publication. The gas companies wished to enforce a provision that the whole of the accounts should be published in the local newspaper. In the case of a small undertaking this would be a serious item of expense, and therefore the promoters asked that the accounts should be published in the prescribed form, and that they should be obtainable by any ratepayer at a small charge. He ventured to hope that Clause 2 fully carried out the decision of the Committee, and he felt that by inserting the words "in the judgement of the undertakers," it would show in the clearest possible way that it was the duty of the Council to apply that judgement honestly in these matters on the occasion of revision. In Sub-Sec. B they had made it clear that there should be more frequent revisions if the promoters so desired it. It was made clear that such revisions should be carried on in the same manner. Sub-Sec. 3 with a slight exception was in accordance with what the gas companies were asking. Where the promoters had gone beyond the decision of the Committee was in the insertion of the words, "save with the consent of the Board of Trade." The object was that there might be special contracts entered into in respect of which the contract could not be made unless it was for a long period. The most familiar of such contracts were those entered into with tramway companies. Tramway companies were willing to enter into contracts to take electrical energy from local authorities if they could obtain it on as low terms as they could make it for themselves, but before they made their capital arrangements and laid down the tramway, they had to consider once and for all whether or not they were going to put up a generating station or obtain the electricity from the local authority. In the interests of the

ratepayers, a tramway company was one of the most profitable of all consumers, because it required a large supply over a long period, and it was always the object of a municipal authority, as well as electric lighting companies, to get tramway companies as consumers. If, however, a tramway company could not get a contract over a long period, it would be bound to put up its own generating station. If a contract had to be subject to a triennial revision, tramway promoters would not go into it, because they would fear that the price might be raised if there was incompetence on the part of the supplying authority. Therefore, with great respect, he asked that the Committee would allow it to go the Board of Trade to say whether it was a proper contract for the local authority to go into, and to which they could give their consent. Another case was that of a large hotel being erected where those responsible would, in building the hotel, have to consider whether it would be remunerative for them to make their own electric light.

The Chairman: Your argument goes to this extent, that every large undertaking, of whatever kind, would have to be supplied on special terms. So far as I can see, you refer to every great undertaking which is going to consume a large amount of electrical energy.

Mr. Knox said it would apply to every undertaking which could profitably erect its own generating station, but, he might say, that the number of such undertakings which could fulfil that condition was becoming smaller and smaller each year, and in Maidenhead, for instance, there would probably be but two or three concerns which would be in a position to do so. In the earlier days of the electric light a good many concerns thought it profitable to supply themselves with the current, but experience had shown that it was only the very large user that could do so profitably. Still there were a certain number of undertakings now, the promoters of which before commencing their works had to consider the question, and in those special cases, he asked the Committee that the municipal authority, rather than lose such good customers, should have power to go to the Board of Trade and get their special consent as to the terms of the contract.

The Chairman: In the case of a tramway it would always have to go to Parliament.

Mr. Knox said they might go to the Light Railway Commissioners, or go for a provisional order under the Tramways Act. If they went to the Light Railway Commissioners, he did not think they would have power to excuse a local authority in a matter like this; but if the promoters went to Parliament, perhaps the same difficulty might not occur, as a special provision might be put in the Act.

Mr. Wedderburn, K.C., said that the decision in this case would, of course, affect the decisions in the other cases, and he asked if the Committee would hear something from the other promoters before giving a decision.

Sir Ralph Littler, K.C., said he was concerned in an unopposed order, and would like the opportunity of being heard.

The Chairman said the decision of the Committee was not to insert the provision in the unopposed orders. It was only in the case of the opposed. Where it was agreed to, as in the case of the Huddersfield Order, they would insert a clause, but where it was not asked for, they did not propose to insert it.

Mr. Wedderburn said that when a decision was once come to in this case, it would be rather hopeless when an exactly similar case came up to expect a different decision.

The Chairman: I rather fear so.

Mr. Paddon suggested that the Committee should hear the different cases, and reserve their decision till the last one was heard.

The Committee assented to this course being adopted.

Mr. Paddon, for the gas companies, then read the following clause, which, he suggested, should be inserted in the orders:—

Clause 7a.

"1. Within one month of the date on which the undertakers shall make up their annual statement of accounts, in pursuance of Sec. 9 of the Electric Lighting Act, 1882, they shall in each and every year publish such statement of accounts in the same form, and the same shall be made up as aforesaid by inserting such accounts in each of two successive weeks in a local newspaper circulating in the district.

"In case the undertakers make default in complying with the provisions of this sub-section, they shall be liable to a penalty not exceeding 40s. for each day during which such default continues

"2. The undertakers shall, at the expiration of the period of three years from the date of the passing of the Act confirming this order, and thereafter at the expiration of every further period of three years, revise, fix, and thereafter maintain the prices to be charged for energy to be supplied by them for the then ensuing three years (but not exceeding the maximum prices specified in this order), so that as far as reasonably practicable there shall be no deficiency of income to be charged upon or paid out of the local rate, as defined in the schedule to the Electric Lighting Act, 1882, and so that the annual revenue of the undertaking shall not be less than the annual expenditure (which expression shall for the purposes of this section include charges on revenue account and charges for interest on moneys borrowed, and instalments of principal and sinking fund); and in estimating the expenditure for any such period after the first revision of prices under this section, the undertakers shall take into account and provide for any deficiency of income in any former period of three years.

"3. In every year after the expiration of one year from the date of the first revision of prices under Sub-sec. 2 of this section, the auditor prescribed by the Electric Lighting Acts, 1882 and 1888, in respect of the undertaking shall within 14 days of the completion of the audit in each year of the accounts of the undertaking, report to the Board of Trade whether the undertaking has, during the year to which such audit relates, been carried on so that there was no deficiency of income for such year, to be charged or chargeable upon the local rates, as hereinbefore defined, and whether the prices current at the date of such audit are sufficient to make the annual revenue of the undertaking equal to the annual expenditure, and if such auditor report that such current prices are not sufficient for such purpose, the Board of Trade shall forthwith fix the price to be charged by the undertakers for energy to be supplied by them during the remainder of the then current period of three years, so that, so far as reasonably practicable, the annual revenue of the undertaking shall not be less than the annual expenditure.

"4. Nothing in this section shall prevent the undertakers from entering into contracts for periods extending beyond the periods at which any revision may take place under the provision of this section on special terms under special circumstances not applicable to ordinary consumers, but each such contract shall provide that the price to be charged for energy supplied under such contract shall either (*a*) be subject to revision at the periods of revision provided for in this section, or (*b*) vary *pari passu* with any variation of prices charged to ordinary consumers made during the existence of such contract, provided that the undertakers shall not, without their consent, be required to accept any price lower than the minimum price mentioned in such contract.

"5. Subject to the provisions of this section, the undertakers may, if they think fit, at the end of each year, revise the prices (other than prices fixed by the Board of Trade) to be charged for energy to be supplied by them.

"6. There shall not be made against the district rate, or any other rate, for energy used by the undertakers for street lighting or any other purpose, a charge at a higher price than that charged consumers using energy for similar purposes, and for the like hours of supply."

The clause submitted by Mr. Vesey Knox for the Maidenhead Order, he contended, did not put into practice the decision of the Committee. For instance, the first section of Mr. Knox's clause dealt with publication, and Mr. Knox suggested that a municipality, with its large organisation and important financial position, was afraid of the trifling expense sought to be imposed on it of publishing the accounts *in extenso*. The position of the gas company was that of a ratepayer only, and in asking for this publication of accounts, they represented the whole of the ratepayers. Their whole object was that the position of the undertaking should be properly known, and to simply put a notice in the paper that the accounts were ready, and leave it to the ratepayers to buy them, would defeat that object, for they knew the ordinary ratepayer would not pay for the accounts. He submitted that Mr. Knox's clause defeated the whole point as to publication.

The Chairman asked if the provision as to publication made in the gas company's clause had any precedent.

Mr. Paddon said it embodied the spirit of the Electric Lighting Act of 1882.

The Chairman: But that does not enforce publication in newspapers?

Mr. Paddon said the Act stated that the accounts should be published in such manner as may from time to time be prescribed by the Board of Trade. What the gas company suggested was that it should be published in the newspapers. He suggested publication by advertisement, while Mr. Knox's clause would still keep the accounts in the background. On Sec. 2 of Mr. Knox's clause, they were at grave issue, because although the clause to a certain extent reflected the recommendations of the Committee, yet it took the whole of the efficiency out of them by an omission which was met in the last three lines of the gas companies' section, viz., "After the first revision of prices under this section, the undertakers shall take into account and provide for any deficiency of income in any former period of three years." He contended that those words were essential, or otherwise the three years would be a period in which they could exercise their extravagance and not be answerable for it in any way. He could understand the municipal authorities objecting to it if it was a question of one year, but this gave them three years, and when the day of reckoning came he asked that they should look back and make good any loss.

The Chairman: Do you mean the first three years after the passing of the Act?

Mr. Paddon: Certainly.

The Chairman: For instance, in this case are they to take into account any deficiency between 1904 and 1907?

Mr. Wedderburn pointed out that the gas companies' clause was inconsistent.

The Chairman said he did not know whether Mr. Paddon was asking that the deficiency should be made good in the first three years of the undertaking, or in the three years after the revision.

Mr. Paddon said what he asked for was that when they fixed the price for the next three years, going up to six years, then any loss which might have been made in the first three years should have been adjusted by the end of the six years.

The Chairman: If you meant that, then your clause does not say so.

Mr. Paddon said that the third section of the gas companies' clause simply provided the machinery for ensuring that the principle of the previous section was carried out. With regard to the Board of Trade allowing contracts, he submitted that if a person entered into a contract, and subsequent adjustments had to be made, it was no hardship. Inasmuch as these contracts represented a large proportion of the business which a municipality might engage in, the suggestion rather vitiated the general principle of the clause.

Mr. Knox replied to Mr. Paddon, and contended that his clause carried out the decision of the Committee.

Mr. Pelham, who appeared for the Board of Trade, said he would not express any opinion on the clause generally, only so far as it referred to duties to be imposed on the Board of Trade. Certain duties were put upon the auditor, but that the Board of Trade had nothing to do with. The Board of Trade only appointed auditors in the case of companies. In the case of local authorities, the auditors were appointed by the corporations or by the Local Government Board. It had been suggested that Sub-sec. 3 of the clause of the gas companies seemed to make the revision annual instead of triennial. The Board of Trade were not interested in that, but they did object very strongly indeed to the duty being imposed on them. They had no staff for the purpose and it would be necessary to hold a local inquiry into the circumstances of each case, and it would be a very expensive and very troublesome duty, which the Board of Trade was quite unable to undertake. It would not only affect electric lighting, but would form a precedent for other things. The Board of Trade had never been called upon to fix actual prices. They fixed maximum prices sometimes. It was quite impossible for the Board of Trade to know all the exigencies of local trade, and it would be a very complicated duty to fix actual prices, and impossible for them to undertake the duty. The only remark he had to make as to the clause of the promoters, was that the Board objected to the duty sought to be imposed on them as to contracts. It might not be so objectionable if it were limited to statutory undertakings like tramways, but if the Board of Trade had to go into the question of contracts for hotels in Lancashire and Yorkshire, they might be called upon to decide contacts for every cotton mill and large place of business, and that was a duty they did not think they could undertake.

Mr. Paddon said the companies were quite willing to abide by the decision of any official of the Board of Trade, or of an arbitrator appointed by the Board of Trade.

Mr. Hutchinson then submitted the same clause as that read by Mr. Knox for insertion in the Hampton Wick order.

Mr. Wedderburn also submitted the clause for the Coombe and Malden order. He said all the promoters had met together and agreed upon the clause, and he asked the chairman to say whether the time had not arrived when they could take one of the clauses as a basis to work upon.

The Chairman said the Committee would take Mr. Knox's clause as a basis to work upon.

Mr. Wedderburn, in reply, contended that they ought to have some power to go before a tribunal in a special case and say, "unless we can make a contract within three years we shall be prejudiced." There certainly ought to be an opportunity to do something in a special case. The question was what was the best tribunal. They had thought that the Board of Trade would be the best, but they had found that that was impossible on account of the Board of Trade's unwillingness to undertake further duties. With regard to the proposal to advertise, it did not follow that all the inhabitants would read the same paper. He ventured to think that in five years' time not half-a-dozen copies would be wanted if the details were published in a special form and charged for.

Mr. Blennerhassett (for Bath) considered the newspaper idea a waste of money. There was one question of great importance; it was the clause dealing with public lighting. That question had not been raised until now by the gas company.

The Chairman asked if the gas company were asking for the clause now.

Mr. Thessiger, for the gas company, said they were.

Mr. Blennerhassett said that he had not heard one single word about the public lighting until just then. He asked the Committee to say that so far as Bath was concerned that matter was disposed of. The question was one of considerable importance, and he had several witnesses whom he would have called, but as the matter had not been raised he had sent the witnesses away. He would not go into the merits of the clause, because he would ask the Committee to say that that matter could not be reopened. It was an attempt to get the clause at the last moment.

Mr. Thessiger (for the Bath Gas Co.) asked that the Committee should consider the matter. It was not a question of evidence at all, but a question of principle. The clause was not inconsistent with the Bermondsey clause.

Mr. Blennerhassett reminded the Committee that he had refrained from arguing the clause.

The Chairman said that he must say that the whole matter was very inconvenient.

Mr. Blennerhassett offered to bring his witnesses another day, when he would be willing for the matter to be discussed.

Mr. Thessiger said that his argument was that the clause was an application of part of the Bermondsey clause.

The Chairman said that if that were so it ought to have been brought up when the other clauses were brought up. After further discussion, he said that he was afraid that he must rule that the counsel for the gas company could not be heard.

A lengthy argument ensued as to whether Mr. Paddon could be heard on the same point, Mr. Paddon contending that when he addressed the Committee, although he did not specifically refer to the clause, yet he intended his remarks to cover it. The room was cleared, and the Committee decided that they could not hear counsel.

The Committee then considered which clause they should adopt, their deliberations lasting some half an hour. On the readmission of parties, the Chairman said that the Committee had decided to adopt the clause submitted by Mr. Knox, amended as follows:—

"1. The undertakers shall, so soon as the annual statement of accounts of the undertakings under the order, and under the Maidenhead Electric Lighting Order, 1898, has been filled up in the form prescribed by the Board of Trade under the Electric Lighting Act, 1882, publish in a newspaper circulating in the borough a notification that such statement of accounts has been filled up, and that copies of it can be obtained at the offices of the undertakers at a price not exceeding 1s. a copy, and such publication shall be in addition to and not in substitution for any publications prescribed by the Board of Trade under the Electric Lighting Act, 1882.

"2. The undertakers shall, on the expiration of the third complete financial year after they have commenced to supply electrical energy under this order, and on the expiration of each third succeeding year, reconsider and, if necessary, revise so far as is reasonably practicable, and thereafter maintain the scales of prices charged for electrical energy under this order, and under the Maidenhead Electric Lighting Order, 1898, respectively, so that no rate will be required for the purpose of defraying the future expenses of the said undertakings during the next three years; provided, nevertheless, that—

"(*a*) The prices to be charged shall not exceed the maximum prices which may be charged under this order and the Maidenhead Electric Lighting Order, 1898, respectively;

"(*b*) The scale of prices so reconsidered and revised may be from time to time in like manner reconsidered and revised by the undertakers.

"3. Nothing in this section contained shall prevent the undertakers from entering into contracts for periods which may extend beyond the periods at which any revision may take place under the provisions of this section on special terms under special circumstances not applicable to ordinary customers, but each such contract shall provide that the price to be charged for energy supplied under such contract shall either

"(*a*) Be subject to revision at the next triennial revision provided for in this section, or

"(*b*) Vary in the same proportion as the prices charged to ordinary consumers.

"Provided that the undertakers shall not without their consent be required to accept any price lower than the minimum price mentioned in such contract."

Supply of Electricity Bill.—The following lords have been named to form a Select Committee on the above Bill:—Marquis of Bath, Earl Ellesmere, Lord Colchester, Lord Stanley of Alderley, and Lord Wolverton. The Bill proposes a number of important alterations in the Electric Lighting Acts. By Clause 1 it authorises the the Board of Trade by provisional order to authorise any local authority, company, or person, who are authorised by any provisional order or Act of Parliament to supply electricity in any area, to acquire compulsorily for the purpose of a generating station any land specified in the order, whether situated within or without the area of supply, and, in the case of a local authority, whether situated within or without their district. In Clause 3 the Board of Trade may, by provisional order, authorise any company or person to supply electricity in bulk to any local authority, company, or person, authorised to supply electricity in any area, for the purpose of distribution by that local authority, company, or person in the area. Clause 4 sets out that the Board of Trade may, by provisional order, exclude the application of the power of purchase given by Sec. 2 of the Electric Lighting Act, 1888, as respects the whole or any part of any undertaking authorised after the passing of the Act, to which they consider it is inapplicable, either by reason of the undertaking not being such as can be properly carried out by local authorities, or by reason of any other special circumstances affecting the undertaking. The Board of Trade may also, where they think fit, by provisional order, allow of the exercise of electric lighting powers by authorities jointly.

Rotherham Corporation Bill.—The omnibus Bill promoted by the Rotherham Corporation came before Mr. Heywood Johnstone's Select Committee of the House of Commons on Wednesday, June 22nd. Mr. Gerald Fitzgerald opened the case for the promoters. Having dealt with the gas and water proposals in the Bill, counsel proceeded to deal with the electrical section of the measure. He said that the Corporation's electrical undertaking was authorised by a provisional order in 1898, and they commenced supplying in 1901. Altogether, they had spent about £45,455 on the undertaking, and supplied their own tramways, which were authorised in 1900, and opened in 1903. The Bill proposed to empower the Corporation to construct a number of short lengths of tramways, and to give them further powers in relation to the supply of electrical energy without the borough. One of the clauses was to empower the promoters to make an allowance by way of discount, not exceeding the rate of 10 per cent. on the amount due in respect of any charges for electrical energy supplied by them if paid within a certain time. The Corporation also took power to supply fittings. The Committee passed the preamble, so far as the electrical sections were concerned, but limited the discount allowance to 5 per cent.

Opposition withdrawn.—The Barry Railway Co. has withdrawn its opposition to the Caerphilly order in Electric Lighting Confirmation Order Bill (No. 8), and the National Telephone Co. its opposition to the Harrogate Waterworks Tramway. The Lancashire and Yorkshire Railway has also withdrawn its petition to the West Riding Tramways Bill, and as there are no other opponents the Bill will go to the Unopposed Bill Committee. All opposition has been withdrawn to the Radcliffe Tramways and Improvements Bill.

Belfast and North-East Ireland Electricity and Power Gas Bill.—The Bill came on Tuesday before Lord Morley's Committee of the House of Lords on Unopposed Bills, and was ordered to be reported for third reading. It incorporates a company with a capital of £1,500,000, to supply power, electricity, and gas in parts of the counties of Londonderry, Antrim, Down, and Armagh.

New Committee.—A House of Lords Committee, consisting of Earl Lauderdale, Earl Bradford, Lord Clements, Lord Chesham, and Lord Elphinstone has been appointed to consider the following Bills:—Electric Light Provisional Order No. 4; Kingswood Order, which is opposed; Tramways Confirmation No. 1 Bill; and the London United Tramways Bill. The Committee will meet on July 4th.

Royal Assent.—The Speaker has reported that the Royal Assent has been given to the following Bills:—Electric Lighting Orders Confirmation No. 1 Act; Great Northern and City Railway Act; Metropolitan Railway Act; Govan Electric Lighting (Further powers); Chesterfield Corporation Tramways and Improvements; St. Marylebone Electric Lighting Act; Lancashire Electric Power Act; and the Preston, Chorley and Horwich Tramways Act.

Barrow-in-Furness Corporation Bill.—Sir Henry Aubrey Fletcher's Select Committee of the House of Commons has passed the preamble of the above Bill, which, amongst other things, provides for the construction of a short length of tramway, and authorises the Corporation to borrow £18,000 for tramway purposes.

Petitions.—Messrs. T. B. Clarke Thornhill and E. Woodhouse are opposing the Calverley U.D.C. order in the Electric Lighting Confirmation Order Bill (No. 1); the London, Camberwell, and Dulwich Tramway Co. has deposited a petition in the Private Bill Office of the House of Lords, relating to the London County Council Tramways Bill.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending June 30th, 1903.		Week ending June 28th, 1904.	
Adelaide	Value £17	Alexandria	Value £40
Alexandria	28	Amsterdam	136
Amsterdam	126	Antwerp. Elec. fuses	388
Auckland	80	Auckland	191
Bangkok	40	Bangkok	18
Bombay	29	Bombay	28
,, Teleg. mat.	178	,, Elec. machinery	87
Buenos Ayres	111	,, Teleg. mat.	40
Calcutta	466	Bordeaux	17
,, Teleg. mat.	784	Brisbane	96
Cape Town	2,035	Buenos Ayres	878
Constantinople	105	Calcutta	341
Delagoa Bay	121	,, Teleg. mat	190
Durban	nil	Canary Islands	25
,, Teleg. mat.	383	Cape Town	115
East London	325	,, Teleg. mat.	627
Hamburg. Teleg. mat.	970	Colombo	71
Hobart	900	,, Teleg. mat.	57
Lisbon. Telephones	42	Delagoa Bay	450
Melbourne	306	Durban	195
Montreal	42	,, Teleg. mat.	38
Ostend	40	Ghent	44
Perth	322	Gibraltar	32
Port Elizabeth	30	,, Elec. machinery	1,045
Rotterdam	13	Halifax	105
San Sebastian	38	Hamburg	15
Santander	20	,, Teleg. mat.	150
Shanghai	27	Hobart	16
Sydney	102	Hong Kong	41
,, Teleg. mat.	67	,, Elec. machinery	33
Yokohama	108	Madras. Teleg. mat.	529
		Melbourne	95
		Ostend	8
		Perth	87
		Port Elizabeth	1,298
		,, Elec. machinery	23
		Rouen	25
		Shanghai	824
		,, Teleg. mat.	103
		Sydney	117
		Tientsin	17
		Wellington. Elec. cars	3,730
		Yokohama	44
Total	£7,790	Total	£12,349

Foreign Goods Transhipped.

Auckland. Elec. mat.	Value £16	Barbadoes. Elec. apprts.	Value 32
East London. Elec. mat.	9	Calcutta. Elec. apprts.	110
,, Telephones	170	Canary Islands. Elec. apprts.	134
Melbourne. Elec. mat.	18	Durban. Elec. instruments	43
Total	£213	Total	£319

Messrs. Johnson & Phillips's Cable Factory.—Messrs. Johnson & Phillips have now completed the recent extensions to their cable department; we understand that the new shops include the very latest equipment for the manufacture of dry-core telephone cables, and they are at present engaged on an order for the General Post Office amounting to some 730 miles. The whole of the new machinery is of their own design and manufacture, as also are all the motors and electric power plant used in the factory, and it is satisfactory to know that this system of driving shows a considerable saving over the former method of using separate steam engines. A construction and cable-laying department has now been organised, and is fully employed on Admiralty contracts for the Portsmouth and Pembroke Dockyards, as well as cable-laying at Handsworth, Weymouth, Birkenhead and Ipswich extensions. We understand that at the end of the present financial year the firm propose opening a vulcanised bitumen shop, and laying down certain wire-drawing plant for drawing their own copper wire.

Cooling Towers.—We learn that Messrs. Matthews and Yates, Ltd., of Swinton, have just recently supplied Messrs. Donat and Co., of Manchester, with the 9-ft. fans for the Preston Corporation towers, and also the Klein Engineering Co., Ltd., with similar fans for Calcutta.

Self-Aligning Trolley Head.—The difficulty of quickly replacing a de-wired trolley wheel of the swivelling type upon the trolley wire is a constant source of irritation and delay, and many attempts have been made to devise means to facilitate the process. The accompanying illustrations show a very simple device, the

Fig. 1.

invention of Mr. F. H. Hadfield, of Durban, S.A. (London address, c/o Messrs. Geo. Curling, Wyman & Co., 58-59, Bunhill Row, E.C.). As will readily be gathered from the figures, when the wheel is off the wire, the spindle is pressed upwards by a strong spring, causing two little runners on arms attached to the spindle to engage with inclined planes which bring the wheel into alignment with the pole (fig. 1). Directly the wheel is replaced on the wire, the upward pressure of

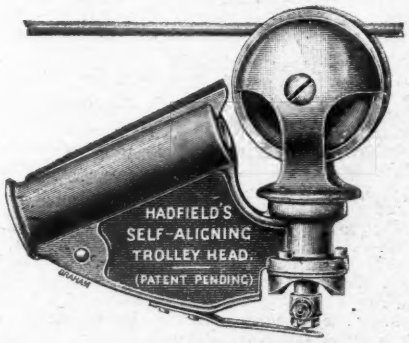

Fig. 2.

the pole forces the wheel carrier downwards upon a ball bearing, in which position the inclined planes are out of gear with the runners, and the spindle is perfectly free to swivel (fig. 2). The head is made of magnalium for lightness, and the other parts of bronze. The simplicity of the device is a strong point in its favour.

Cowans' Switchgear.—The following contracts have lately been booked by Messrs. Cowans, Ltd., of Victoria Street, S.W.:—

Ealing.—H.T. feeder board and extension to generator board.
Acton.—Extra H.T. main switchboard.
Cardiff.—Main L.T. switchboard.
Bristol.—Arc lighting switchboard.
Royal Courts of Justice.—Main switchboard.
Poplar.—L.T. switchboard for motor-generators, &c.
Fife.—Extra H.T. main switchboard.

Diagram Measurer.—An ingenious instrument, devised by Prof. D. A. Low, of East London Technical College, has been introduced by Messrs. Longmans, Green & Co. The device is extremely simple, consisting of a sheet of transparent celluloid, 6¼ in. × 3 in., printed with a series of equidistant longitudinal and transverse lines at right angles. To measure the area of a diagram, the instrument is placed upon it, so that the diagram is divided into a number of parallel strips, the area of each of which can be at once read off, and added together by a simple process. No marks whatever are made on the diagram, and any ordinary diagram can be measured with the instrument, despite variations in length. A variety of set squares, tee-squares, protractors, &c., devised by Prof. Low, is also obtainable from Messrs. Longmans, Green & Co., at 39, Paternoster Row, E.C.

Australia.—The Australian Customs authorities have lately given a decision to the effect that "Auto-transformers, not being static transformers, are to be classified, for purposes of import duty, as machinery appliances, n.e.i. electrical," the duty being 12½ per cent. *ad valorem*.

A.B.P. Batteries.—The A.B.P. Accumulator Co., Ltd., have just completed the erection of a battery consisting of 256 cells at the Leek electricity generating station, and one of 250 cells of their 23-plate type at the Corporation power station, Northampton. They have also delivered a complete battery of 58 27-plate cells to Constantinople.

Bankruptcy Proceedings.—The public examination was held on Tuesday at the London Bankruptcy Court, before Mr. Registrar Linklater, of Charles Aubery Smith, electrical engineer, 23, King Street, Regent Street, W., who applied to pass upon accounts showing liabilities £644 10s. 1d., and assets valued at £776 19s. 11d. Questioned by Mr. E. S. Grey, Official Receiver, the debtor said the business was established by his grandfather in 1846, and was carried on by his father until June, 1901. The latter then died, leaving the business to the widow, who continued it under witness's management, until the following September, when she transferred it to him under a verbal arrangement that he should pay her £900 for the outstanding book debts, and should take over the other assets and all the liabilities. Witness continued the business under the old style of C. J. Smith, until March 29th last, when Messrs. Bolding & Son obtained a judgement, levied execution, and subsequently sold off the effects on the premises. Witness since taking over the business had collected part of the book debts, and had paid sums on account to his mother, who was now a creditor for £500. He had not returned that as a debt in the statement of affairs, because he did not anticipate that any claim would be made by his mother. That debt would increase his liabilities to £1,144, and would consequently convert his surplus to a deficiency. He attributed his failure to want of capital, bad debts, depression in trade, and inability to collect the book debts. This was his first failure. The debtor was also questioned by Mr. Frank Brough, on behalf of Mr. R. J. Ward, the trustee, and the examination was then ordered to be concluded. Appended is a list of the principal creditors, viz.:—

UNSECURED.

Builders' Material Supply Stores	£11 14 6
Baxter & Caunter	12 2 7
Bolding & Sons	94 5 8
Braby & Co.	13 19 0
Edison and Swan United Electric Light Co., Ltd.	86 5 3
Electrical Co., Ltd.	10 3 6
Electrical Sundries Co.	11 10 0
Hope, Alfred J.	11 14 6
Pfeil, Stedall & Son	23 11 11
Smith, J. & W. B.	34 11 7
Sax, Julius	19 8 0
Wright, J.	71 10 0
Thursfield, C. J.	10 0 0
Beer, Hasluck & Co.	19 6 0
Smith, J.	10 0 0

PREFERENTIAL.

Rent	£50 0 0
Income-tax	17 8 4
Wages	13 14 4

Dissolutions and Liquidations.—The Reliance Electric Co., Ltd., of Manchester, is winding up, with Mr. E. W. Bundy, 85, Phillips Park Road, Bradford, Manchester, as liquidator.

Messrs. H. Turner and C. R. D. Bearcroft (H. Turner & Co., electrical engineers, 15, New Broad Street, E.C.) have dissolved partnership. Mr. Bearcroft will attend to debts.

The Thames Valley Launch Co., Ltd., is winding up, with Mr. F. J. Saffery, of 14, Old Jewry Chambers, E.C., as liquidator.

Before Mr. Justice Buckley in the Winding-up Court on Tuesday, the petition of Estler Bros. in reference to Messrs. Ferranti, Ltd., was heard. It was stated that the late Mr. Justice Byrne had appointed a provisional liquidator; the debenture-holders had got possession, and there being contracts, which were liable to forfeiture, an order was made giving effect to an arrangement between the debenture-holders and creditors. The matter had stood over from time to time pending the completion of a scheme of reconstruction, which was still under consideration. Mr. George Henderson added that the amount to be received in respect of the valuable orders to be carried out by the provisional liquidator was about £70,000. After paying everybody there would be left about £25,000 as working capital, and this was considered sufficient. His Lordship granted a further adjournment to August 2nd to allow of the perfection of the scheme.

Book Notices.—"Pocket-Book of Useful Formulæ and Memoranda for Civil and Mechanical Engineers" (25th edition). By Sir Guilford L., Henry B., and Walter H. Molesworth. London: E. & F. N. Spon, Ltd. 6s.

"Electricity in Agriculture." By Prof. S. Lemström. London: *The Electrician* Printing and Publishing Co., Ltd. 3s. 6d.

We have received a copy of the Jubilee issue of *The British Journal of Photography*, in which we find the portraits of the fathers of photography. It is well worthy of a place on the library shelf for future reference, being full of interesting matter, both for professionals and amateurs.

The Great Eastern Railway Co. has, as usual, issued some exhaustive handbooks for the purpose of guiding the would-be holiday maker. One is entitled "Holidays in the Eastern Counties," and sets forth the attractions of those parts, giving some taking sketches and half-tone illustrations. Another is a full list of farmhouses and country lodgings.

We have received a copy of the Special Electric Power number of *Cassier's Magazine* for June. It is devoted entirely to articles (well illustrated as usual) on the subjects of electric power, its transmission and distribution (2s. 6d.).

"Electric Motors." By H. M. Hobart. London: Whittaker and Co. 12s. 6d. net.

For Sale.—The Ayr Corporation electricity department is offering a number of Aron alternating-current meters for sale. See our advertisement pages to-day.

The Exeter Corporation is offering various engines, alternators, arc lighting machines, meters, &c., for sale, consequent upon the change of system. Some particulars are given among our advertisements to-day.

Electrical Pumping in Collieries.—We are informed that Messrs. E. Scott & Mountain, Ltd., of Newcastle, have recently secured a contract from the Ashington Coal Co., Ltd., for an extensive installation of electrical pumping machinery for their Ashington collieries. The current will be taken in two circuits from the main switchboard in the generating room, one circuit being taken down the Bothal shaft, and the second circuit down the Carl shaft; from the bottom of these shafts the three-phase current will be distributed at a pressure of 500 volts, to the various pumps underground. From the Bothal shaft an existing endless rope haulage gear will be driven by a 30-B.H.P. electric motor, and from the same cables current will be taken to the five sets of pumps with a total capacity of 750 gallons per minute, against heads varying from 120 ft. to 329 ft. In the Carl pit there will be two pumps at the shaft bottom each delivering 75 gallons of drinking water per minute, against a head of 600 ft., and in addition there will be four sets of pumps distributed underground having a total capacity of 650 gallons per minute, delivering against heads varying from 150 ft. to 290 ft. In the relief pit a set of main shaft pumps will also be provided to deliver 300 gallons per minute, against a head of 317 ft. The whole of these pumps, together with the electric motors, which will be of the three-phase, slip-ring, induction type, will be of Scott & Mountain's Newcastle manufacture. The pumps are of their three-throw horizontal type.

The electric motors will be of the three-phase, slip-ring, induction type, wound for 500 volts, and all motors will be complete with motor-room switchboards. In the shafts the cables will be of the three-core type, armoured with galvanised iron wires, and underground, the in-by cables will also be of the three-core type, unarmoured, but suitably supported. It is claimed that this installation, when completed, will be the largest three-phase electric pumping installation in the North of England. The same firm, we also understand, have a considerable number of other contracts in hand for collieries, &c., including:—

Consett Iron Co.—Plant delivering 4,500 gallons per minute against a head of 800 ft.
Croxdale Colliery.—2,000 gallons per minute, 720 ft. head.
Bekermet Mines, Cumberland.—600 gallons per minute, 1,300 ft.
Harton Coal Co.—Three sets of pumps delivering collectively 700 gallons per minute, 1,600 ft. head.
Benwell Colliery.—300 gallons per minute, 600 ft. head.

Catalogues and Lists.—Another addition to the set of pamphlets published by the BRITISH WESTINGHOUSE Co. has reached us. It contains an illustrated description of the steam turbine installation of the Yale and Towne Manufacturing Co., of Stamford, Conn.

A catalogue of tangential water-wheels has been sent to us by the ABNER DOBLE Co., of San Francisco.

MR. C. R. HEAP, of Victoria Street, S.W., is sending out a 12 pp. descriptive list of the Bogue dynamos for electro-plating, electro-typing, and general electrolytic work. Mr. Heap has the sole agency for these machines in the United Kingdom.

MESSRS. J. HOPKINSON & CO., LTD., of Huddersfield, have this week published an excellently got-up catalogue (52 pp. art printing with numerous half-tone pictures) detailing their safety valves, which at this date need little introduction to a central station engineer. The patent "Duad," "Voc," "Sprivoc," "Duvoc," "Trivoc," "Marivoc," "Dulam," "Ipsed," "Dused," "Sprised," and various other types of safety and relief valves and accessories are shown. Sizes and prices are tabulated.

MESSRS. JAMES CARTER & SONS, of Stalybridge, are issuing a new circular relating to their fuel economiser (Pembley patents). A description with some large sectional and other views, is given, also extracts from testimonials, diagrams of comparative results in heating efficiency, results of experiments on the heat absorptive power of water and other interesting information.

The surface condensing plant installed at the Manx electric railway power house at Laxey is described in a list received from the MIRRLEES, WATSON Co., of Glasgow.

Sheet No. 87 of MESSRS. E. F. MOY series, describes their No. 87 type distributing boards.

Some new circulars of Luna "flame" arc lamps, electric fans, electric measuring instruments, high tension switchboards, electric pumping plant, generating and other machinery for mining installations, portable drilling machines, &c., have been received from the ELECTRICAL CO., LTD., of Charing Cross Road, W.C.

The SUN ELECTRICAL CO., LTD., of Charing Cross Road, W.C., have issued a new list of fan motors for various types of fans for the current season. A special line is the electric punkah fan, which is claimed to be in results the nearest possible approach to the Indian hand-pulled punkah. Ceiling and wall and desk types of fans for alternating and continuous current circuits are shown and priced.

The DIRECT SPANISH TELEGRAPH CO. has issued a small handbook of some 20 pages, giving particulars of its lines, also the tariff of charges and rules and regulations which come into force on July 1st.

The HORSFALL DESTRUCTOR CO., LTD., of Leeds, has issued a new edition of its "Details" catalogue in which some of the latest special features embodied in the Horsfall system are referred to. Some clearly printed illustrations appear of clinkering doors, back-feeding doors, hoppers, a patent clinker railway, clinker-crushing plant. Views of the commercial and machine-shop departments at the Lord Street works are shown.

Refuse Removal.—Messrs. Matthews & Yates, Ltd., of Cyclone Works, Swinton, have received a large order from the Brush Electrical Engineering Co., Ltd., Loughborough, for a Cyclone collecting plant in connection with their car-building sheds.

Receiving Order.—We understand that a receiving order has been made against H. Binko & Co., electrical and general engineers, on the action of a large creditor of the Patent Speaking Tube Co., Ltd., for which company they guaranteed several thousand pounds. There is a lawsuit for a claim of £15,000 now pending between the Patent Speaking Tube Co. and the Commercial Union Assurance Co., and if this is decided in favour of the plaintiffs there will, it is stated, be more than sufficient to pay all liabilities. The liabilities of the general electrical business are said to be very small, and to be more than covered by book debts and other assets.

France.—The balance-sheet of the Compagnie Continentale Edison, of Paris, for the last financial year shows a profit of £42,440, as compared with £42,768 in the preceding 12 months.

Imports of Foreign Electrical Goods and Apparatus.—While the imports of foreign electrical machinery into this country show a slight decrease, those of electrical goods and apparatus continue to steadily advance, the value of such imports during May last having amounted to £60,931, as compared with only £58,937 in the preceding month. For the five months ending with May, the returns show that the imports of foreign electrical goods and apparatus into the United Kingdom reached a total of £327,928, which contrasts with only £300,480 in the corresponding period of last year, and £283,702 in the first five months of 1902.

Heathman's Trestles.—Messrs. J. H. Heathman & Co., of Parson's Green, S.W., are now supplying a new folding hoist trestle of special design, which is claimed to be particularly suitable for raising and lowering accumulators in electrical stations. By its aid, it is stated, one man can raise 300 lbs., and rollers are fitted on the table, so that the batteries can be slid over on to the shelves when the table is raised to the level thereof. The whole thing is portable, as it folds up very compactly.

Trade Announcements.—Messrs. Barr & Stroud have now moved into the new works which they have built at Anniesland, and their address in future will be Caxton Street, Anniesland, Glasgow, W.

Readers are asked to take note that the style of "The County of London and Brush Provincial Electric Lighting Co., Ltd.," has been changed to "The County of London Electric Supply Co., Ltd."

Messrs. Wm. Gard & Co., electrical engineers, of Canterbury, have opened a branch establishment at 87, Preston Street, Faversham.

Messrs. Jaeger Bros., manufacturers of electrical accessories, have removed their London office from 39 to 47, Victoria Street, Westminster, S.W.

Mr. George F. Mackay, has resigned the position held by him as manager of the electrical department at Messrs. William Harvie and Co.'s works, McAlpine Street, Glasgow, and along with Mr. Grier, the late secretary and a director of that company, has joined with Mr. Maxwell Telford, electrical engineer and dairy specialist, at 338, Pollockshaws Road. The new firm will be known by the name of Telford, Grier & Mackay, Ltd., having their offices and works at 220—222, Broomielaw, where they will deal with all kinds of electrical work. Special attention will be given to the application of electricity to power, mining, and the lighting and ventilating of ships. They have also equipped a department for the repair of all kinds of electrical machinery. Electrical firms are invited to send trade catalogues and terms.

Messrs. Saxby & Farmer, Ltd., have removed their head office from Kilburn to 53, Victoria Street, Westminster, S.W., where all communications should be addressed.

LIGHTING AND POWER NOTES.

Aston.—The dispute which has arisen between certain consumers and the Electricity Committee, in regard to the charges made for energy, has led to a defence fund being formed, and nearly 100 consumers have agreed to share any action at law that may be deemed advisable to contest the legality of the Electricity Committee's action in regard to the accounts. It has been resolved by certain of the ratepayers to obtain legal assistance, and to secure the advice of an experienced electrician.

The Electricity Committee, on the 7th ult., decided that the accounts in dispute should be referred to the borough treasurer and electrical engineer to be considered on its merits, and to be subsequently investigated by the Committee, but this suggestion has not proved satisfactory in the way of settling the dispute.

Belfast.—The Harbour Commissioners have decided to erect two 4-ton electric cranes on Queen's Quay, as an experiment, for working the coal traffic.

Bolton.—With the sanction of the B. of T. the T.C. has reduced the price of energy for tramway purposes from 1·25d. to 1·10d. per unit.

Bo'ness.—The Secretary for Scotland has granted permission to the T.C. to borrow £25,000 to defray the cost of completing the work of the E.L. scheme. The Secretary had previously withheld his consent. It is pointed out that the decision of the Secretary is not to be held as creating a precedent, and that the whole question of working agreements under Sec. 11 of the E.L. Act, as in the Bo'ness case, is now under review.

Bury (Lancs.).—The Electricity Committee of the T.C. has fixed the following charges for energy:—Places of worship, offices, banks, workshops, warehouses, public halls, and other short-hour consumers, 5d. per unit on the flat rate, instead of 6d. and 3d. on the maximum demand system; shops, 4½d. per unit; hotels, public houses, private consumers, &c., 4d. per unit; power, 2½d. per unit, or 3d. on the maximum demand for an average of one hour per day, or 1,000 units per quarter, and 1d. per unit beyond.

Carnarvon.—The T.C., on the 23rd ult., resolved to purchase a site for its generating station in Balaclava Road for £1,000. Mr. Price White, of Bangor, has been appointed consulting engineer to the Corporation at a fee of 100 guineas.

Cheltenham.—An indignation meeting of ratepayers was held last week to protest against the continued losses on the electric lighting undertaking; resolutions were passed calling upon the chairman of the Electricity Committee to resign, and advocating the promotion of a special Bill in Parliament for the appointment of a Government auditor. It was stated that there was a deficit of £17,000 on the undertaking, and the suggestion that the bankers who had advanced the money should lose it was received with applause!

Chertsey.—The B. of T. has informed the U.D.C. that it contemplates revoking the Staines, Egham and Chertsey E.L. order, as the Thames Valley Electric Supply Co., Ltd., has not moved in the matter, and the Council has decided to support the revocation of the order.

Christiania.—The proposed sale of the electricity works at Kykkelsond, which are owned by the Schuckert Electricity Co., has not been carried into effect. The municipal authorities made an offer of 5·40 million kronen for the works, whereas the Schuckert Co. demanded 5·75 millions, which has, however, been refused by 52 votes to 30.

Cromer.—On the 27th ult., by invitation of Messrs. Edmundson's Electricity Corporation, many of the townspeople visited the electricity works on the occasion of the official inspection.

Ellon.—The report of a company was submitted to the T.C. recently, showing that the cost of installing the electric light in the burgh would be £2,950. It was agreed to ask if the company would proceed with the scheme on its own initiative, when the Council would consider taking over the plant at some future date, but it would not bind itself in any way.

Foot's Cray.—The Bexley U.D.C. recently considered terms for supplying electricity in bulk to the parish, offered on behalf of Mr. R. C. Baines, of Woodford, Essex. Mr. Baines, it was stated, was about to purchase the prov. order from the Foot's Cray U.D.C. The terms offered to the holders of the order were up to 20,000, the fixed minimum supply, 4½d. per unit, and 2½d. per unit afterwards up to 100,000 units. Mr. Mittelhausen, the Bexley Council's engineer, recommended the acceptance of Mr. Baines's offer, but the Council has resolved to postpone the matter for 12 months.

Germany.—It has been decided to establish an electricity works in the town of Schwabmünchen.

Hanley.—A loan of £5,800 for E.L. purposes has been granted to the T.C. by the L.G.B.

High Wycombe.—The local E.L. & Power Co. has asked the T.C. whether it is prepared to consider an offer for lighting the town by electricity. The Council has given an affirmative reply, providing that the scheme will give improved lighting.

Holyhead.—The U.D.C. has decided to apply to the L.G.B. for sanction to borrow an additional £1,000 for the extension of mains and electric lighting plant. The tender of the National Electric Construction Co. for carrying out the required work for the sum of £1,750 has been accepted.

Ipswich.—The accounts of the electricity supply department for the period ending March 31st last, show that the total expenditure amounted to £2,109, and the total receipts, including £1,782 for energy supplied to the tramways, £2,463, leaving a gross profit of £354; interest and sinking fund charges amounted to £2,517, so that the charge upon the rates was £2,163.

Kalk Bay.—The Government has assented to the Municipality negotiating a loan for the purpose of supplying the town with electricity.

Leek.—The U.D.C. has resolved to apply to the L.G.B. for sanction to borrow £1,800 for mains extensions.

Lewisham.—The B.C. has received details from the surveyor of the damage done during the past six months by public companies breaking up roads and footpaths, and has decided to make claims for the following amounts:—Blackheath and Greenwich District E.L. Co., £1,085; Lewisham and District E.L. Co., £361; Crystal Palace District E.L. Co., £8.

London.—ST. PANCRAS.—At a recent meeting of the B.C. the statement of the electric lighting accounts for the year ending March 31st was submitted. The expenditure on capital account during the 12 months was £38,677, which brought the total capital expenditure up to £460,368. In the following details the figures for the preceding year are in parentheses. The total revenue for the 12 months was £75,774 (£68,373). Of this £63,143 (£55,939) was from private consumers; from public lighting and all maintenance charges in respect thereto, £11,367 (£11,183). The chief items of revenue expenditure were:—Works costs, £29,270; law expenses in Colwell and others *v.* B.C., £1,462; rent, rates and taxes, £2,335; special charges, £1,656; interest, £13,381; payment of instalments, £6,122. The result was a net profit balance on the year of £20,583, as against £16,818 in 1903. It was proposed by the Committee to dispose of the surplus, together with the £530 carried forward at the beginning of the year, as follows:—£2,551 to writing down capital; £16,000 to be added to the reserve fund; £2,319 to be carried forward. The borough treasurer and accountant reported that a total of £709 had been paid from the electricity account last year for income-tax. He suggested that in future in order to save this payment, either the surplus net profits made each year (after providing for depreciation on mains, machinery, and plant, which, approximately, is £5,000 per annum, and should be taken from the profits yearly to the reserve fund) ought to be transferred to the rates, or the net price of energy to the consumers should be at regular intervals reduced or adjusted. If either of these courses were carried out very little, if anything, need be paid in future for income-tax. The report was adopted without discussion.

FULHAM.—Energy is to be supplied by the B.C. to the Grand Theatre on the following terms:—40,000 units at 3d., 20,000 units at 2¾d., all additional units at 2½d., with a minimum annual consumption equivalent to £500. The Council is to fix the necessary transformers and switchgear, and to run the necessary high-tension mains from the nearest sub-station to a chamber to be provided by the theatre authorities, such chamber to be absolutely under the Council's control, a rental of £10 per annum to be charged by the Council for the transformers, &c. The borough electrical engineer has pointed out that, if desired, a supply at either 100 or 200 volts could be given, and that an additional low-tension supply would be brought in from the distributing network outside the theatre. This would provide a partial supply should a breakdown occur on the transformer circuit.

MARYLEBONE.—At a special meeting of the B.C., on June 28th, motions were unanimously adopted to borrow £500,000 from the London and Westminster Bank, and £800,000 from clients of Messrs. Pember & Boyle, the interest being at the rate of 3½ per cent., including commission to the brokers. The loans are to run until October 20th next, when they will be paid off with an L.C.C. loan, obtained under the Act recently passed. A resolution was passed directing the treasurer to pay the company on June 30th, the date fixed by order of the Court, the sum of £1,248,347 13s. 4d. The items making up this were:—Amount of award, £1,212,000; capital expenditure, additional to the £80,000 previously paid on account, £20,953 16s. 6d.; estimated May and June expenditure, £12,500; interest on the two foregoing sums, £890 16s. 10s.; costs of the various appearances before the courts, £1,200; proportion of rates, £803.

HAMPSTEAD.—The B.C. has decided to expend the sum of £356 in erecting an additional sub-station, the main in the Kilburn High Road being now fully loaded.

ISLINGTON.—The revenue account for the year ending March 31st last, shows a surplus of £1,054, as against a deficiency of £1,496 for 1902-3. The chief items on the debit side were:—Total works costs, including public lighting, £27,655; interest on loans, £12,180; repayment of loans, £6,173. The total revenue from the sale of energy amounted to £48,352, and of this sum, £32,705 was received from private consumers. The loans outstanding amount to £379,618.

WOOLWICH.—The B.C. has decided to extend its E.L. mains, at a cost of £3,637.

Loughborough.—The T.C. has received from the L.G.B. sanction to borrow £5,000 for E.L. purposes.

Manchester.—The accounts of the electricity department for the year ending March 31st last have just been published. They show better results than those of the previous 12 months, a net profit being shown of £6,800. These accounts do not embrace those of the tramways department. The committee reports that the capital outlay during the year was £396,805, making a total to March 31st, 1904, of £2,110,432. As no further borrowing powers have been necessary during the period under review, the total still stands at £2,246,121. Additional powers, however, are now being sought, under resolution of the City Council, to the extent of £135,000, principally for extension of mains, and the sanction of the L.G.B. is expected shortly. On the recommendation of the chief engineer, the committee has decided to install two turbo-generators at the Dickinson Street generating station of 750 KW. capacity each, in place of certain belt-driven sets of smaller size. Tenders for the work were obtained, and a contract has been entered into with Messrs. C. A. Parsons & Co. for the supply and erection of two Parsons-Siemens turbo-generator sets to the specification of Mr. Pearce, and it is expected that both these sets will be completed by November 30th next. As to the Stuart Street station, the committee reports that the plant required in connection with Dr. Kennedy's installation of 15,000 H.P., and the equipment of the various sub-stations in connection has been completed, and all the steam plant and electrical apparatus has been run on load at various times under ordinary working conditions. Official tests have been carried out, and the results attained proved satisfactory. The contractors for the additional 12,000 H.P. installation are proceeding with the erection of the machinery and plant under Mr. Metzger's supervision. It is expected that the whole will be completed and ready for work by the end of January, 1905.

The total output of electricity from the works during the past 12 months amounted to 38,610,922 units, as compared with 22,198,241 units in the previous year, an increase of 73·93 per cent. The quantity measured and accounted for during the same time was 31,597,293 units, showing a difference of 7,013,669 units, or 18·17 per cent., being the quantity not accounted for. The total mileage of mains laid at March 31st, 1904, equals 284 miles 1,427 yards. The net profit for the year is stated to have been £6,808 12s. 7d.

The development of the undertaking during the last two or three years has been very rapid, as shown by some statistics at the end of the report. The total Board of Trade units sold in 1895—the first full year of work—were 1,168,382. In 1900 the sales had risen to 6,355,872. Two years later the figures stood at 10,502,299, and last year the units sold amounted to 17,400,223. The supply of energy for traction purposes was commenced in 1902, the consumption then being 1,951,990 units, and in the following year 7,986,072, whilst in the 12 months ending March 31st last the tramways consumed no less than 17,125,857 units. The number of units used for public lamps in the city last year was 41,553, or some 1,200 more than in the previous year, but less than in each of the years 1899, 1900 and 1901.

Melton Mowbray.—The U.D.C. has accepted the tender of the local E.L. company for street lighting by electricity for five years at £325 per annum. There will be five arc lamps of 1,000-C.P. each, three 260 C.P. lamps, four 130-C.P. lamps, 17 25-C.P. lamps, and 130 25-C.P. lamps.

Newcastle-under-Lyme.—The opening of the Corporation electricity works took place on the 22nd ult. The chairman of the Electric Supply Committee stated that the whole scheme, including the laying of the mains, &c., had been completed at a cost of £5,400. The number of 8-C.P. lamps connected is 1,994, and it was stated that as the present capacity of the plant was only 2,080 8-C.P., the laying down of additional plant would have to be considered. The works adjoin the Corporation gas undertaking, and the plant comprises two 60-H.P. Stockport gas engines, by Messrs. Andrews & Co., rope driving two 30-KW. E.C.C. generators. The switchboard, by Messrs. Crompton & Co., is arranged for a three-wire D.C. supply at 230 volts; an E.P.S. battery of 130 cells has been installed. The mains were supplied by Messrs. Callender, a feeder carrying the total energy required to a pillar in the centre of the town, from which distributors are run over the compulsory area. The price charged for private lighting is 6d. per unit, and it is intended to supply electricity for power also. The electrical engineer is Mr. J. F. Shoolbred, formerly at Stockport.

Portsmouth.—The T.C., on the recommendation of its Roads and Works Committees, has decided to light all the new roads in the borough by electricity, at a cost of £3 3s. per lamp, and £6 6s. per double lamp; for 500 or more, £3 per lamp and £6 per double lamp, the cost of converting the lamps to be borne by the E.L. Committee.

Retford.—The Retford Town Council has decided to employ an expert to act with the Gas Committee in drawing up a comprehensive scheme for supplying electricity in the borough. At the meeting at which this decision was arrived at, it was stated that the T.C. had obtained a prov. order empowering it to supply electricity, but that it had expired, and the B. of T. had refused to renew it unless the T.C. was able to show that it was taking steps to carry out the work.

Rosherville.—A conference has been arranged between representatives of Gravesend Corporation and the Northfleet U.D.C., in regard to a proposal to extend the Gravesend E.L. order so as to include Rosherville.

Sheffield.—On Monday last the new electrical generating station of the Corporation at Neepsend was formally opened by Alderman Styring, chairman of the E.L. Committee. A large company, including members of the Council and prominent officials, the Master Cutler and leading citizens, assembled to witness the ceremony. The Lord Mayor, in opening the proceedings, said he considered the occasion marked a distinct step in the advance and progress of municipal undertakings in Sheffield. In the year 1898, when the electric light undertaking was taken over by the Corporation, the gross revenue was £19,000. For the last financial year this amount was increased threefold, whilst the number of units supplied showed a fourfold increase. A very pleasant feature of the building was to his mind the fact that, so far as the architecture was concerned, the whole of the plans and specifications were prepared by their own staff, and the works had been carried on under their supervision. Mr. S. E. Fedden, the general manager and engineer, pointed out that in starting the new station they were faced with the difficulty of having to make enormous excavations. They found, however, that the soil was suitable for making an ordinary stock brick, and accordingly put down a plant and made their own bricks, and turned this excavating work from a drawback to a very real advantage. The total expenditure on the station had been about £100,000. The engine room was an exceptionally large one, being wide enough for the erection of steam turbines of 6,000 KW., and high enough for the erection of vertical engines

from 5,000 to 6,000 H.P. Alderman Styring was then presented with a silver key by the contractors, and declared the building open. After other brief speeches, those present inspected the new buildings.

South Shields.—The annual report on the Corporation E.L. undertaking for the year ending March 31st last has been issued by Mr. J. H. Cawthra, the borough electrical engineer. The total capital expenditure to date is £149,357. The gross revenue for the year was £17,166, as against £15,718 in the previous year; working expenditure, £6,601, as against £6,118; the gross profit for the year being £10,565, as compared with £9,600 a year ago. £4,869 was set aside for interest on loans, and £4,070 to sinking fund, leaving a balance on the year's working of £1,625, which, after a deduction is made of £22 for loss on Holborn Quay, leaves a balance on the year's working of £1,604. The units sold were 1,299,289, an increase of 150,324 on the previous year, or equal to 13 per cent. The total revenue showed an increase of 9 per cent., and the gross profits an increase of 10 per cent. Lamp connections had risen from 47,674 to 53,837, or 13 per cent.; consumers had increased from 906 to 1,010, or 11 per cent. The average price obtained for supply was: Private consumers, 3·8d. per unit; public lighting, 1·3d. per unit. A reduction of 14 per cent. had been made on the works cost. The reserve fund stands at £2,415, and Mr. Cawthra recommends that the whole of the surplus be placed to the reserve account.

Spain.—An electricity works at El Chorro, Malaga, has just been completed. The water power of the River Guadalhorce is being utilised, and the capacity of the plant installed is about 1,500 H.P.

Stirling.—In his annual report to the T.C. on the working of the E.L. undertaking for the year ended May 15th last, Mr. A. C. Hanson, the electrical engineer, states that the number of units generated amounted to 228,790, as against 194,076 the previous year. The result was that instead of having a deficit of £37 as estimated, there was a surplus of, approximately, £80. On the recommendation of the engineer, the Council resolved to reduce the charges for meter rents.

Sunderland.—The Electricity and Lighting Committee has decided to oppose the decision of a Parliamentary Committee ordering it to pay costs incurred through its petition against the Sunderland Rural District Lighting Bill. After the Committee had entered the petition, it did not appear to support it, and hence the order to pay. The Corporation's Parliamentary agents have advised that, as it was decided not to continue the opposition, as has been done in many other cases, the Parliamentary Committee exceeded its rights in ordering costs against the Corporation. The matter will be brought before a meeting of chairmen of Parliamentary Committees. The costs are said to amount to £500.

Tamworth.—The R.D.C. has received intimation that the T.C. intends to apply to the B. of T. for a prov. order to supply energy to the parishes of Wigginton, Bolehall, and Glascote.

Taunton.—Incandescent lamps are to be fixed to the arc lamp standards at a total cost of £180, and it is estimated that this will effect an annual saving of £180 on the public lighting account. In order to meet the demand for the hire of motors, the T.C., on the recommendation of its committee, has decided to enter into a seven years' arrangement with the Langdon-Davies Motor Co. The revenue from the working of the undertaking for the year ending March 31st last., was £8,040, while the expenses were £4,512, leaving a balance on the year's working of £3,527, amounting to 5¾ per cent. on the capital expenditure. After deducting all charges, including interest and principal on loans, there is a surplus of £9. The units sold amounted to 532,351.

Tewkesbury.—The Chepstow and Ross Electricity Co. has informed the T.C. that it intends applying to the B. of T. for a prov. order for supplying energy in the borough.

West Ham.—The electrical engineer, Mr. W. J. W. Bullock, advised the Council, with a view to disposing of the marked prejudice against the present arc lighting rates, and in order to induce shopkeepers and others to adopt this form of lighting more widely, to reduce the minimum charge of 17s. 6d. per lamp per quarter, plus 2d. per unit, to 15s., the price of energy to remain the same. In the event of a consumer installing lamps of more than 500 watts, the Corporation to have the right to increase the fixed charge. This was agreed to. The electrical engineer was asked to report as to the disposal of the old generating station, &c., and three Lancashire boilers there. Mains extensions estimated to cost £1,271 were authorised.

TRAMWAY AND RAILWAY NOTES.

Aston Manor.—The Miller Street to Cross Section of the newly-equipped tramline was officially inspected last week by Lieut.-Col. Yorke, and intercommunication with Birmingham has now been resumed after six months' delay.

Beckenham.—A correspondent writes as follows regarding the local tramway situation:—"The U.D.C. sat till nearly midnight at its last meeting discussing the subject of electric trams. For many years past now, the question has been a weighty one in Beckenham. The district is a high-class residential one, and the general feeling was against trams, but recognising after several attempts on the part of outside companies to get powers for the neighbourhood, that they could not much longer stem the modern tide, the local Council decided to promote a Bill in Parliament, and in the event of the Bill becoming an Act to lease the lines after construction to the British Electric Traction Co. The agreement entered into with the company was considered locally to be most favourable to the district, and on a poll being taken, the ratepayers by an overwhelming majority endorsed the Council's action. In due time the Council received their Act, which became operative on January 1st last. For some months negotiations have been proceeding between the Council and the company as to the security the latter would give for the due performance of their contract, the sum being £10,000. This was settled two or three weeks ago, but at the last meeting, Mr. George Sutton, one of the members recently elected, moved that they enter into negotiations with the B.E.T. Co. with a view to cancellation, on terms, of the agreement between the Council and the company as to the construction and leasing of tramways in Beckenham. In support of this motion, he said that the scheme would be detrimental to the interests of Beckenham. The amount that would fall upon the rates during the two years of construction would be £3,357, and it would not be until the year 1911 that the income would overtake the expenditure. He attacked other financial proposals, including the proposed expenditure of £62,000 on street widenings, and urged that of this sum £21,000 would fall upon the rates. The length of line he pointed out, was only one mile and two-thirds. The defence of the scheme was taken up vigorously particularly by Mr. A. J. Lees, who was the exponent of the Council's views at the public meeting held for the purpose of getting the ratepayers' approval to the Council's scheme before the Bill in Parliament was promoted. The remark was made that all this action to end the scheme was rather outside the legitimate bounds of discussion, inasmuch as the ratepayers and the Council had passed the scheme, and they were committed by their Act of Parliament to carry out the agreement with the B.E.T. Co. After a prolonged and very animated debate, the motion was rejected by the narrow majority of nine to seven, and, on a division being called for, by a majority of one only."

Belgium.—The only tender received by the municipal authorities of Ghent for the introduction of the overhead system of traction on its electric tramways in place of the unfortunate accumulator system was that of the Société Electriques de Gaud, which offered to pay a sum of £3,600 per year, plus a variable annual amount based on a rate of 17·05 per cent. of the profits distributed among its shareholders.

Birmingham.—The Pershore Road route was officially inspected by Colonel Yorke last week.

Buenos Ayres.—The German Transmaine Electricity Co., of Berlin, has just decided to increase it share capital from £800,000 to £1,100,000 for the purpose of extending supply operations at Buenos Ayres. The augmentation is due to the fact that the company has made arrangements with the Anglo-Argentine Tramway Co., of London, for the supply of power during the whole period of the latter's concession, and the prospect is said to exist of the conclusion of a similar agreement with the city of Buenos Ayres Tramways Co. as soon as this company's lines have been converted to electric traction. In order to carry out the first arrangement, the German company is acquiring the power station built for the Anglo-Argentine Co. at Buenos Ayres, which has been temporarily transferred to it for several months past.

Dundee.—At a meeting of the Tramways Committee last week, the engineer was asked to *again* bring forward his scheme respecting motive power charges, giving the members longer time to consider the matter, and furnishing fuller details.

Germany.—An electrical trolley-omnibus service is being established between Vörde, Melspe, and Gevelsberg.

Glasgow.—In the House of Commons on Tuesday, Mr. Gerald Balfour, answering Mr. Weir, said that the Glasgow Corporation had informed him that the number of accidents causing injuries to persons on its tramway system in the year ended 31st ult. was 100, of which 19 were fatal. During the same period there were 28 accidents causing material injury to property. In the year in question the cars ran 16,291,082 miles and carried 188,962,600 passengers.

Great Northern and City Railway.—On the morning of the 23rd ult. there was a stoppage of the trains for half an hour owing to a short-circuit which occurred among some cables in a trench under the signal box at Moorgate Street Station. The signal box is an iron structure with concrete flooring. As usual, the affair was ridiculously exaggerated in some of the evening papers.

Greenock.—The Board of Trade has appointed Mr. Richard Brown, C.A., Edinburgh, as arbiter on the difference which has arisen under the tramway agreement with reference to the Corporation's claim to a share in the tramway profits.

Halifax.—The T.C. has been recommended to extend the electric tramways from Brighouse to Bailiffe Bridge at once, at an estimated cost of £10,000.

Ipswich.—The accounts of the Tramways Department for the period ending March 31st last shows the expenditure as follows:—Power, £1,687; traffic expenses, £3,097; general expenses, £759; repairs, £548; total, £6,091. The receipts were £5,644. Interest and sinking fund charges amount to £1,473, leaving £1,920 chargeable on the rates of the borough.

Leicester.—Owing to the fact that traffic on the new electric tramways has exceeded anticipations, the Tramways Committee has ordered 40 new cars from Messrs. Dick, Kerr & Co., Ltd., at £510 each, the price under the original contract. Additional car-shed accommodation is being arranged for.

Liverpool.—On Monday afternoon a trolley wire in Lime Street, Liverpool, broke, causing some delay in working the traffic. The officials were able to improvise a short relief route, which admitted of the traffic being worked after the first period of delay while the wire was being reinstated.

London.—For the approaching service of electric cars in the populous districts of Tottenham, Wood Green and Edmonton, power is transmitted over a great distance from the power station which has recently been erected by the North Metropolitan Electric Power Supply Co. on the banks of the River Lea at Brimsdown, Enfield. Some particulars of this station have already been given in the Electrical Review. The pressure adopted is 11,000 volts at Brimsdown. The energy is conveyed by a duplicate system of high-tension mains laid underground, which are tested up to 20,000 volts. This is reduced at various sub-stations in the tramway area to 500 volts continuous current. It is believed that this is the only instance of such a high pressure transmission in England for the purposes of tramway working.

Camberwell.—Lieut.-Col. Yorke has reported the result of his inspection, on behalf of the Board of Trade, of the London, Camberwell and Dulwich tramlines, as follows:—"The tramways have deteriorated very much since my last inspection in July, 1901, and their present general condition is bad, and such as to be an 'annoyance to the ordinary traffic,' and at many places the holes in the paving alongside the lines are likely to be dangerous to vehicles. To attempt to repair the line would be useless, and merely entail a waste of money. Nothing short of entire re-construction can be of use. The only alternative is to abandon the lines and remove the rails. I recommend that, in the interests of public convenience and safety, the tramways should not be permitted to remain any longer in their present condition."

Manchester.—The Corporation Tramways Committee on Tuesday issued its report on the working of the tramways during the year ended March 31st. This is the first year the entire system has been in full operation. At the date of the previous annual report, the routes open for traffic aggregated nearly 78 miles of single track. The last year has seen practically an additional 60 miles added, thus bringing the aggregate length of single track over which cars are now run to nearly 138 miles. The following is a statement of the income and expenditure:—

	1903-4.	1902-3.
Traffic revenue	£603,182 6 10	£306,249 15 8
Rent of lines	—	11,234 18 7
Other revenue	8,698 16 10	475 14 11
Total	£611,881 3 8	£317,960 9 2
Working expenses	392,504 7 8	193,989 11 9
Balance, being gross profit ..	£219,376 16 0	£123,970 17 5
Add bank and other interest ..	3,079 10 6	2,595 19 0
Leaving a sum available of ..	£222,456 6 6	£126,566 16 5

The surplus has been applied to payment of interest, mortgage, &c., redemption of debt, reserve, renewals, and depreciation account, contributions in the relief of rates, &c. Last year the latter payment amounted to £50,000, while the year before it was £30,000. Last year the cost of electric energy per car-mile was 1·84d. as against 1·94d. in 1902-3, and the salaries, wages of drivers, guards and traffic staff 2·35d., compared with 2·27d. The total traffic expenses were 3·41d. per car-mile, against 3·53d. in 1902-3; and the total management expenses ·67d. against ·75d. Repairs and maintenance cost ·86d. per car-mile last year, and ·73d. in the previous 12 months, the total operating expenses being 6·78d. per car-mile last year, against 6·95d. in 1902-3. The population served by the tramways is approximately 750,000, and last year 120,772,368 passengers were carried, electric cars travelling 13,617,448 miles, and horse-cars and omnibuses 141,623 miles. The returns show the 1d. stages to be most popular, the number of passengers by these being 75·20 per cent. of the whole. Halfpenny fares are not in operation on the main routes, but are confined to circular and cross routes.

The electric energy used last year amounted to 16,815,764 units, the number per car-mile being 1·23. The percentage of working expenses to receipts was 64; the average traffic revenue per car-mile, 10·52d.; the average traffic revenue per mile of single track, £4,468; and the average total revenue per car-mile, 10·67d. The working expenses per car-mile, excluding power cost, was 4·94d., while including power cost it was 6·78d. The average fare paid per passenger was 1·2d.; the number of passengers per car-mile averaged nine, and the average journeys per head of the population per annum was 161. The borrowing powers of the department stand at £1,805,560, of which £1,505,668 has been exercised, the gross capital expenditure being £1,485,612.

N.E. Railway.—It is stated in the *Northern Echo* that all traffic on the Blyth and Tyne branch of the N.E.R. was stopped at the busiest time of the forenoon on 22nd ult.:—"A spanner was dropped on the line near the Killingworth crossing between Benton and Backworth, and this established a connection between the live rail and the running rail. The latter was speedily burnt through, and had to be replaced before traffic could be continued."

Rochester.—On Tuesday, the City Corporation considered the tenders for the construction of the permanent way, and of the overhead equipment for the Corporation tramways. Only part of the whole scheme is to be taken in hand now, and the tenders of Messrs. Dick, Kerr & Co., were accepted, as follows:—Permanent way, £5,256 12s.; overhead equipment, £967 11s. 1d. Messrs. J. & W. S. Briscoe were the highest in both instances—£16,208 18s. 6d. and £1,767 11s. 6d. Mr. Rotter is the engineer for the Corporation.

Spain.—The electric railway between Mondariz and Porrino, the construction of which is about to be taken in hand, will be about 13 miles long. It is proposed to eventually extend it to Vigo, a total distance of 23 miles. The water-power of the River Mino is to be utilized in generating the necessary electrical energy, at a point known as Barral, about 15 miles from the line, which will be of metre gauge.

Spen Valley.—The B. of T. has informed Cleckheaton U.D.C. that it does not propose to come to a decision at present on the application of the B.E.T. Co. for permission to abandon the construction of electric tramways from Hightown and Cleckheaton to Hartshead Moor, and that an extension of time to June 22nd, 1905, has been granted.

West Ham.—It was reported at Tuesday's meeting of the Corporation, that the cars were being run at ·84 unit per car-mile. Application is to be made to the Board of Trade for their sanction to the borrowing of the sums required for the electrification of the High Street, Romford Road, and Leytonstone Road lines.

TELEGRAPH AND TELEPHONE NOTES.

Derby Telephones.—According to the *Sheffield Telegraph*, the National Telephone Co. are at present engaged upon an important scheme at Derby. The preliminary part of the work consists of transferring the wires from overhead to underground. Permission to do this has been obtained from the Corporation, and the wires are already laid in several of the principal streets. The town has been divided into over forty areas, in each of which is to be fixed a distributing point. From the exchange to these distributing points the wires will be placed underground. At each distributing point a special post will be fixed, to which, by means of overhead wires, the subscribers of that particular area will be connected.

New Cables in the Far East.—The cable agreement entered into between Holland and Germany some time ago, is now proposed to be amplified by the addition of France, which, according to the Amsterdam correspondent of the *Frankfurter Zeitung*, is also desirous of taking advantage of the opportunity of obtaining a cable connection with Cochin China independent of British cables. It is provided by the Dutch-German agreement that Holland shall extend her East Indian cable line from Java *via* Borneo to the north of Celebes and Menado, while the German-Dutch Cable Co., which has been formed by virtue of the agreement, undertakes to continue the extension until it meets the American cable in the Philippines, where the cable will be carried *via* the Palawan Island to Shanghai, where a German Post Office is situated. Holland and France have now concluded an agreement whereby a a French cable from Saigon is to be connected with the Dutch Indian cable between Pontianak, Billiton, and Batavia. The agreement, which is now awaiting the approval of the Dutch Lower Chamber, provides that all differences which may arise in regard to the arrangement shall be settled by the Hague Court of Arbitration in the event of diplomatic measures proving to be unsuccessful. A similar clause is contained in the before-mentioned Dutch-German cable agreement

P.O. Telephone Wires.—On 22nd ult. a deputation waited on Lord Stanley, Postmaster-General, at the House of Commons, to endeavour to induce him to put the telephone wires now being erected through the village of Harpenden and along the Luton Road, underground. The Postmaster-General and the engineer promised to give every attention to the matter.

Swansea Telephones.—The Committee on Monday considered counsel's opinion on the advisability of applying for a mandamus to compel the National Telephone Co. to grant intercommunication. Counsel advised the taking of proceedings. The meeting adjourned for a week.

Telephone Dispute.—There has been a dispute this week between the female operators at the Holborn Exchange and the N.T. Co. respecting the hours of work. The management had a conference with a deputation from the operators, and as a result, it was agreed that the new duty should be 8½ hours per day, with 5 and 6 hours on Saturday.

Telephones in China.—The Tientsin correspondent of the *Evening Standard* says that the Japanese Secretary of the Chinese Telegraph Service, at the Shanghai office, has been instructed by Yuan-shi-kai to visit Pekin and the Northern districts generally, to report on the expediency and cost of forming an

Imperial telephone service. It is also stated that two other Japanese are about to be engaged in the telegraph service. The same correspondent adds:—"The necessity for an all-British line to Pekin is becoming imperative, and this introduction of Japanese influence into the telegraph service is regarded with disfavour. The present extensive and excellent telephone service in Pekin and the Northern districts is in European hands, and is widely supported by the Chinese officials. Any alteration is quite uncalled for."

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Dominica-Martinique	May 5, 1902	
St. Lucia-Martinique	May 7, 1902	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Cayenne-Pinheiro	Aug. 18, 1902	
Anjer-Kalianda	Aug. 2, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Nagasaki-Vladivostock	Feb. 15, 1904	
Closed { Port Arthur-Chefu	Feb. 18, 1904	
Foochow-Formosa	Feb. 11, 1904	
Accra-Lagos	June 1, 1904	
Chio-Ténédos	June 21, 1904	
Landlines.		
Seoul-Masampo	Feb. 18, 1904	
Seoul-Gensan	Feb. 18, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 2, 1904	
Dominican lines	May 26, 1904	

Wireless Telegraphy.—The *Globe* reports that the Lodge-Muirhead wireless telegraph is now working between Elmers End and two War Office stations at Aldershot and Lewes. The two circuits are separately "tuned" or syntonised to prevent interference of the messages.

President Roosevelt is reported to have appointed a board consisting of Rear-Admirals Evans and Manney, General Greely, Lieut.-Commander Jayne and Mr. Moore, Chief of the Weather Bureau, to consider the question of the use of wireless telegraphy in the service of the United States Government.

The *Times* says that an agreement was signed on Tuesday by which the De Forest Wireless Telegraph Syndicate, Ltd., acquired all the Maskelyne wireless patents.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—July 18th. Pipe-work for the electricity works. See "Official Notices" June 24th.

Batley.—July 16th. The Corporation invites tenders for a 350-kw. steam dynamo, and switchboard extensions. See "Official Notices" to-day.

Belfast.—July 11th. Two portable electric gantry cranes for the Harbour Commissioners. See "Official Notices" to-day.

Bridgend.—July 6th. Telephone and fire alarm installation for asylums. See "Official Notices" June 24th.

Bristol.—July 15th. Switchgear, water-tube boilers, two 1,000-kw. three-phase extra high-tension turbo-alternators, two 500-kw. induction type motor-generators, cables and transformers, for the Corporation electricity department. See "Official Notices" to-day.

Bulgaria.—July 4th. The District Finance Commission at Sophia is inviting tenders until July 4th for an installation of electric lighting in the Government printing works in that city.

Bulgaria.—August 13th. The Municipal Authorities of Philippopolis are inviting tenders until August 13th for the concession for the electric lighting of the town and for the construction and working of an electric tramway.

Clyde.—July 25th. Two 32-ton electric coaling hoists for Clydebank Dock. See "Official Notices" June 17th.

Dartford.—July 19th. Mains extensions. See "Official Notices" to-day.

Erith.—July 11th. Rails, fishplates and bolts; permanent way construction for the U.D.C. tramways. See "Official Notices" June 10th.

Exeter.—July 1st. One 200-kw. engine and generator, condenser, &c. See "Official Notices" June 17th.

Felixstowe.—July 9th. Extensions to feeders. See "Official Notices" June 24th.

Handsworth.—July 11th. Water-tube boilers, engines and dynamos, crane, battery, arc lamps, and posts, switchboard and boosters for electricity works. See "Official Notices" June 24th.

Heston and Isleworth.—July 4th. Electricity meters for the U.D.C. See "Official Notices" June 17th.

Johannesburg.—July 4th. Cables, conductors, and accessories. See "Official Notices" May 13th.

Johannesburg.—July 29th. Steel work for car-shed buildings, and bridge over railway. See "Official Notices" June 17th.

Leicester.—July 5th. Machine tools for the tramway department. See "Official Notices" June 24th.

London.—July 12th. Three 3-ton electric travelling cranes and two electric locomotives for the wharf of the Greenwich power station of the L.C.C. See "Official Notices" June 17th.

London.—July 12th. The L.C.C. wants tenders for various overhead travelling cranes, and lifting tackle for Greenwich station. See "Official Notices" June 17th.

Manchester.—July 11th. The Paving, Sewering and Highways Committee invites tenders for laying underground telephone pipes (Contract No. 10), with other appurtenant works. Specification, &c., at the City Surveyor's office, Town Hall, Manchester (£2 2s.).

Middlesex.—The County Council on June 23rd authorised the engineer to advertise for tenders for the construction of a tramway, 2 miles 3 furlongs and 3·35 chains, from the intersection of Harrow Road and Acton Lane to near the intersection of Horn Lane with Churchfield Road West.

Penrith.—July 5th. Two oil or gas engines and dynamos; switchboard and boosters; battery and mains for electricity supply. See "Official Notices" June 17th.

Portugal.—The municipal authorities of Barcellos are at present inviting tenders for the concession for the electric lighting of the town during a period of 30 years.

Richmond (Dublin).—July 5th. The Joint Committee of the Richmond District Asylum invites tenders for a high-speed engine and dynamo, direct-coupled, for the Portrane Auxiliary Asylum, near Donabate, County Dublin. Specification at the Asylum Offices, Grangegorman, Dublin.

Rochdale.—July 1st. One 412-kw. steam dynamo. See "Official Notices" June 17th.

Rochdale.—July 18th. Turbo and steam alternators; motor-alternator for electricity works extensions. See "Official Notices" to-day.

Shanghai.—July 30th. The Municipal Council invites tenders for a 24-mile electric trolley line concession. Particulars from J. Pook & Co., 63, Leadenhall Street, E.C., the London agents of the Council. See "Official Notices" May 13th.

Spain.—July 10th. The municipal authorities of Priego (province of Cordoba) are inviting tenders until July 10th, for the concession for the electric lighting of the town during a period of 68 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Priego (Cordoba province).

Stepney.—July 4th. Meters, demand indicators, and arc lamp carbons for the electricity department. See "Official Notices" June 24th.

Stourbridge.—July 8th. Mains (paper), solid system for the U.D.C. See "Official Notices" June 24th.

St. Pancras.—July 19th. Main switchboard at King's Road station. See "Official Notices" June 24th.

Swansea.—July 1st. Two tramway switchboards. See "Official Notices" June 24th.

Warrington.—July 12th. Steel poles and overhead equipment for light railways, including special swing bridge work over the Ship Canal. See "Official Notices" June 24th.

Whitby.—July 18th. Cables, network and service boxes for the U.D.C. See "Official Notices" to-day.

(*Continued on page* 24.)

THE NEW HOLBORN TELEPHONE EXCHANGE.

By the recent opening of the New Holborn Exchange at Birkbeck Buildings, the National Telephone Co. has made another important step towards the entire conversion of the London telephone service to the central battery system. Already the Kensington and Battersea exchanges are working on this system; London Wall exchange, providing for 9,500 subscribers, is nearly completed, and central battery switchboards are in course of construction for several other important exchanges.

As we published a full description of the principal features of the central battery system at the time of the opening of the Central Telephone Exchange, we propose in the following account of the Holborn Exchange to confine our attention mainly to the more novel and special features of the installation, of which there are not a few.

Fig. 1.—Part of Switch Room.

The exchange is situated on the upper floors of the building, with ample accommodation for the staff, such as dining and reading rooms; special attention has also been given to the heating and ventilation of the rooms, and provision has been made for the safety of the staff in case of fire. The power plant is situated in the basement of the same building, together with the storage battery which constitutes the mainspring of the whole system.

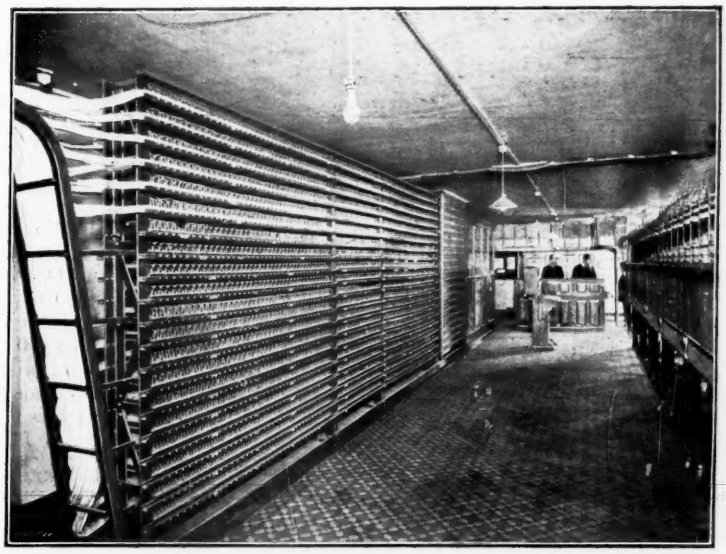

Fig. 2.—Test Room: Repeating Coil Rack, Test Board and Testing Desk.

The subscribers' lines are mostly run in underground dry core cables, but there are also a number of aerial dry core cables. There are 20 cables of the former type ranging in size from 204 pairs to 306 pairs, and 34 aerial cables, all of 52 pairs. The underground cables are jointed to silk and cotton insulated lead-covered cables by means of pothead joints, made in the last manholes, which are situated just outside the building. The silk and cotton cables are led along a cable subway, in which they are supported by means of iron wall brackets, to a well near the centre of the building, and are carried up this well to the test room on the fifth floor by means of a steel skeleton tower, in which the cables are supported by iron cleats. The cables are then carried under a false floor to the testboard.

Fig. 3.—Junction Relay Rack and Horizontal Side of Intermediate Distributing Frame.

The aerial cables are led from the standard directly into an iron rack supported under the ceiling of the test room, in which the pothead joints are made. Silk and cotton cables are led from the rack to the test board. These cables, in connection with the underground and the aerial cables, are connected to lightning arrester and heat coil strips of the usual pattern, from which the lines are cross-connected in numerical order to the test jacks by means of flame-proof twin leads. The test board is shown on the right-hand side of fig. 2. The lines are run from the test board to the intermediate distributing frame by means of fire-resisting cables (20 lines in one cable). We may mention here that all the cables used in the exchange are practically fireproof.

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The individual wires are covered with an insulation of silk and cotton, after which the cable is lapped with lead foil, and lastly, there is an outer fire-resisting covering.

The intermediate distributing frame, which is shown in fig. 3, is an arrangement by means of which any exchange line can be distributed to any part of the switchboard without at the same time interfering with the position in numerical order in the multiple, in order to equalise the work per operator, or for any other purpose. This frame also affords a connecting point between the lines from the test board, the multiple jacks, the answering jacks and the line and cut-off relays.

The cables from the test board are led to the horizontal distributing tabs on the right of fig. 3, from which are run the cables to the multiple jacks: cross connection wires also run from these points to the vertical tabs seen in the right-hand side of fig. 4, and from the latter, cables run to the answering jacks and the line and cut-off relays. The latter are mounted on a rack parallel to the intermediate frame, shown at the middle of fig. 4. There are nine horizontal shelves in the I.D. frame, each carrying 65 strips of 20 tabs each—1,300 lines, making a total capacity of 11,700 lines. Included in this number are tabs for subscribers' lines, outgoing junctions, registers, order wires,

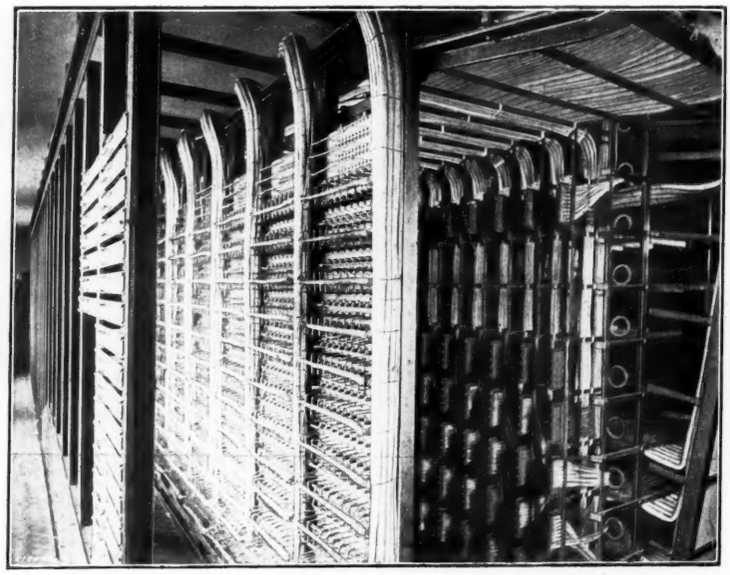


Fig. 4.—Subscribers' Relay Rack, and Vertical Side of Intermediate Distributing Frame.

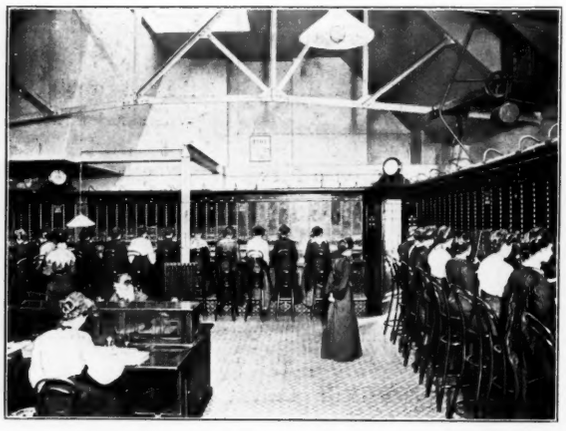


Fig. 5.—Part of the Switch Room.

and miscellaneous and service lines. The total length of the frame is 36 ft.

The relay rack is in two rows, of which the first is fully equipped with 5,280 line and cut-off relays. The two rows together give a total capacity of 10,560 lines. In a corner of the room a register rack is fitted, carrying 2,260 subscribers' service registers: one of these is connected with each message-rate subscriber's line. Part of this rack can be seen at the far end of fig. 3. Connection is made between the registers and the lines by means of tabs and cross-connection wires on the intermediate distributing frame. The rack shown on the left-hand side of fig. 3 carries those junction relays which cannot be accommodated on the back of the sections for the incoming lines from all other London exchanges. To the left of fig. 2 can be seen the repeating coil rack, carrying the repeating coils or transformers used for feeding the connecting cords with current and for dividing the circuit, so that a separate supervisory signal may be obtained from each subscriber. There are 2,038 repeating coils fitted: 17 per subscribers' position, and 25 to 27 per incoming junction position. At the far end of the rack is the fuseboard which carries the repeating coil fuses, one 1-ampere fuse to each coil. Beyond this, again, is the cabinet containing the resistance lamps, which serve a double purpose—first, to check the flow of current over the B line in the event of an earth fault, and secondly, to afford a prompt notification of any such fault.

At the end of the room (fig. 2) can be seen the testing desk, which is equipped with two sets of voltmeter testing apparatus, by means of which the location and nature of almost any fault can readily be determined. The voltmeters are of special Weston type, with two windings, one of 100,000 ohms, and the other of 10,000 ohms; there is also a shunt of 1,111 ohms. Two scales are provided, one reading from 0 to 40 volts, and the other from 0 to 4 volts; by means of special 40-volt and 4-volt batteries, and a series of connecting keys, the insulation resistance of any line from 628 ohms to 15·9 megohms can be determined on the 40-volt scale, and resistances from 6·5 ohms to 1·59 megohms can be read on the 4-volt scale, which can thus be used for measuring copper resistances. The capacity of a condenser can also be approximately determined by the throw.

Fig. 6.—Back View of Switchboard, Junction Sections.

Both the inside and the outside equipment of lines can be tested by junctions to the test board, and also by means of lines to the switchboard terminating on a special position. This position on the switchboard is equipped with a number of plugging-up lines, terminating at the switchboard end in plugs and cords, and at the other end in jacks on the testing table. By means of these arrangements, faulty lines can be plugged through to the testing desk until the fault is cleared. So long as the plug is inserted, a special humming test will be received by any operator testing the line for "engaged," and she will take this as an indication that the line is out of order.

The switchroom now demands our attention. One corner of this is shown in fig. 5. The boards starting from the opening seen on the right, surmounted by a clock, and running to the left, are subscribers' positions; these occupy three sides of the room, which is 108 ft. long and 34 ft. wide.

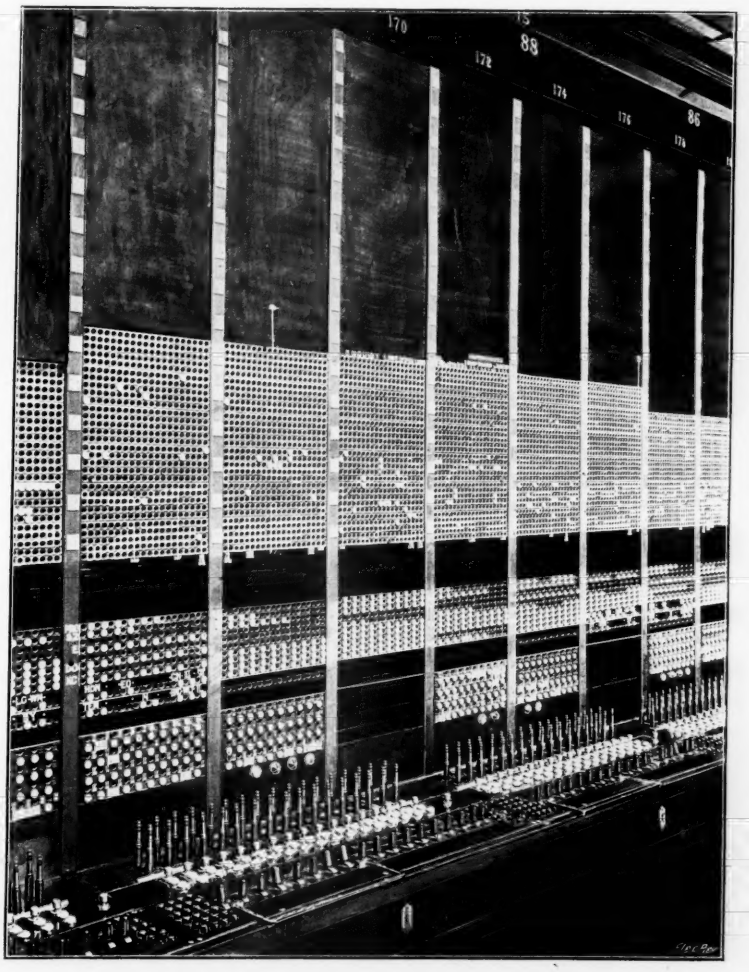


Fig. 7.—Front View of Switchboard, Subscribers' Sections.

The boards which run from the clock to the right are incoming junction boards. In the foreground to the left can be seen the Exchange manager seated at his desk. Two supervisors are also seen standing behind the operators' chairs. There are a total of 71 subscribers' positions, and 36 junction positions in the Exchange; 69 subscribers' positions are at present equipped for 80 lines each. The junction positions are equipped for 25 or 27 lines. The junction circuits incoming at Holborn vary to a certain extent, in order to work in with the exchanges of different types so far unconverted to the standard C.B. system. The circuits have been so arranged, that by a simple modification they become standard and suitable for working between two C.B. exchanges. The total operating staff, including relief operators, is 99. Special attention has been given to obtaining proper supervision. The supervisors, each of whom looks after a group of subscribers' or junction operators, deal entirely with operating supervision, and have a special lamp and instrument jack situated on each of the sections which they control, so that they can communicate with the Exchange manager or chief operator, or *vice versâ*. All complaints and inquiries from subscribers are passed on to special operators known as monitors. Their table consists of four positions, with lines from all the operators and lines to the Exchange manager, chief operator, and testing desk. There are also direct lines to other exchanges, which greatly facilitate inquiries being made at distant exchanges regarding any trouble. It is considered that the efficiency of the operating is increased by this method, as the supervisors' time is not taken up by attending to inquiries or complaints.

The Exchange manager's desk is equipped with lines to all the operators' instrument circuits, lines to monitors, chief operator's and testing desks, and lines for service observation. Any line on which complaint regarding the service is received is connected to one of these lines, and the Exchange manager can follow the operating in detail. Another feature in connection with the Exchange manager's and monitors' tables is the "Instruction Circuit." This is an arrangement by which the Exchange manager or monitors can call all the operators in the exchange simultaneously to ascertain, for example, at what position a subscriber is connected. The diagram on p. 23 shows how this is arranged. The monitor, or Exchange manager, plugs into one of the jacks on the left-hand side; this operates the relay A, which in turn actuates relays B, C, &c., one relay to each section of the board. These light lamps, D, &c., provided with green glass caps, one to each operator's position. The operator depresses key E, which actuates relay F, putting the lamp out, and also connects the operator on the instruction line. The relay F retains and keeps the lamp out as long as the plug is in the instruction jack. It is part of the supervisor's duty to see that the operator connects with the circuit at each position directly her work allows of it, and she can see by the lamp when the operator does this. In obtaining information about such transient things as telephone calls, this arrangement is found to be of great advantage. The chief operator, who deals personally with the operators and supervisors, has a desk somewhat similar to the Exchange manager's, but equipped in a simpler manner.

Fig. 7 is a view of the front of the subscribers' switchboard. On the key-shelf can be seen the 17 pairs of plugs at the back, then a row of 17 register keys, then 17 pairs of supervisory lamps, and to the right another register key for recording "no charge" calls. In front again there is the row of 17 combined listening and ringing keys, and both on the left and right the order wire keys by which the operator communicates with other London exchanges. There are 12 keys on the right-hand side, and 24 on the left-hand side, of each position, making a total of 36.

In the multiple panels can be seen, first, the four special lamps per position, of which the one on the left is the pilot lamp, the next the instruction lamp, then the order wire lamp, and the last one on the right is in connection with the register circuit. Above these are the answering jacks and line lamps, then the outgoing junction multiple. The outgoing junctions are multipled every six panels, and there is equipment provided for 600 outgoing junctions at present. The subscribers' multiple comes above the outgoing junctions.

Fig. 8.—Chloride Storage Battery

If the calling subscriber is on the unlimited service, he has no register, and only the operator's effective call register is actuated. If the call is ineffective or a service one, the common "no charge" key is depressed and actuates the "no charge" call register.

Fig. 9 is a view of the back of a subscribers' section, showing at the top the subscribers' multiple cables, then the outgoing junction cables.

A bunch of the answering jack cables can be seen on the left-hand side of the illustration, rising from the cable trough at the foot of the boards; under the junction cable shelf can be seen the pilot relays, and below these the cord shelves with cord fasteners. Below these again are the cord-circuit resistance spools, insulated with micanite, and then the supervisory relays, one to each supervisory lamp, and each pair marked A and C., viz., answering and calling respectively, for identification purposes. Below these are the connectors, on which the battery, ringing leads, &c., are joined up, and the resistance lamps, one of which is placed in the common ringing circuit of each position.

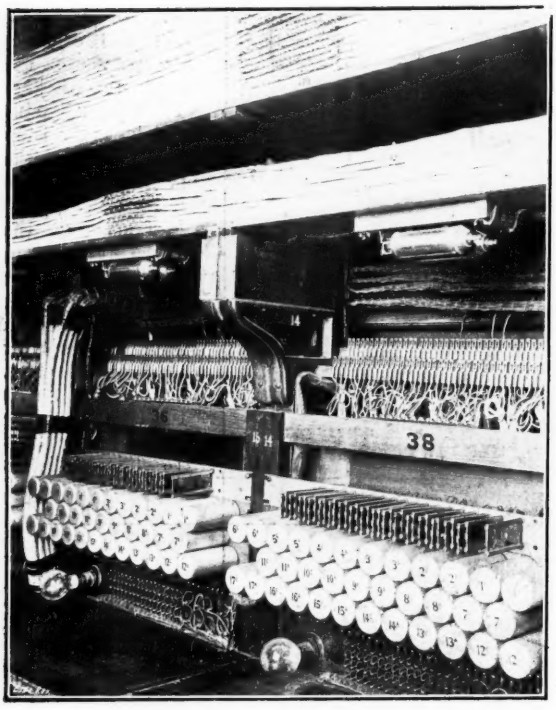


Fig. 9.—Back of Subscribers' Section.

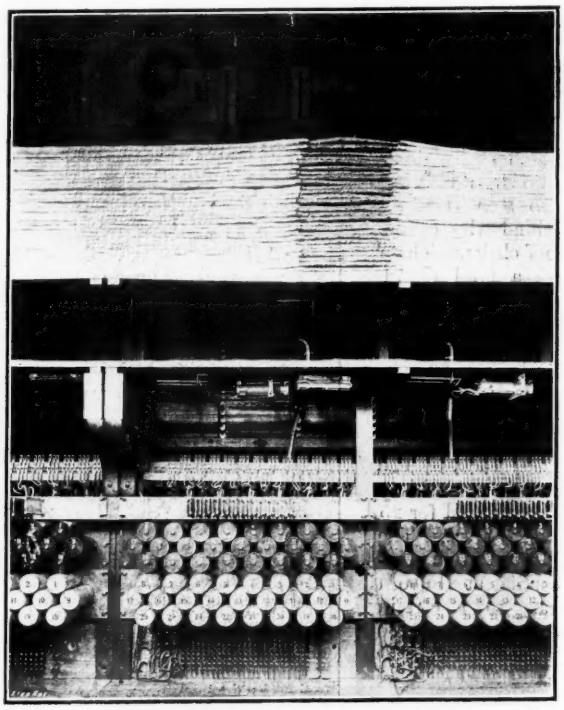


Fig 10.—Back of Junction Section.

The jacks are multipled once every eight panels, and the present multiple equipment is for 4,600 lines, which is now being increased to 5,600.

The operators' service registers are fitted in a cabinet placed in the switch-room. There are two to each subscribers' operator, one for effective calls and the other for "no charge" calls. They are of great service in connection with load records, and for obtaining operating statistics generally. It will, perhaps, be of interest to describe the method of operating with registers. On receipt of the two clearing signals, the operator depresses the register key, which actuates the calling subscriber's register (if a Message Rate line) and the effective call register simultaneously, and lights the register lamp whilst it is depressed, thus informing the operator that a call has been registered. The key is not depressed until the receipt of the clearing signal, in order to ensure that the call is effective.

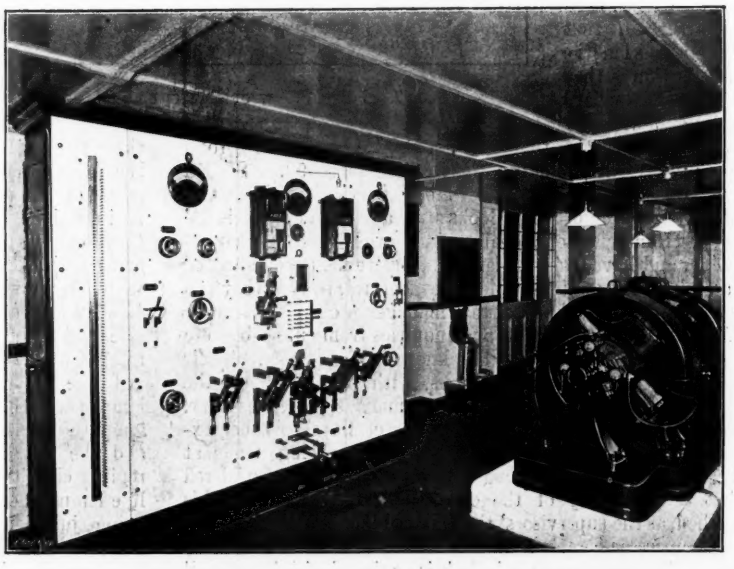


Fig. 11.—Power Board and Motor-generator.

Fig. 9 shows the back of a subscribers' section. At the extreme top are fixed the apparatus in the operators' instrument circuit, viz., induction coil, choking coil, and condensers. The subscribers' multiple comes next, and then the outgoing junction multiple, which is only for 120 lines. On the underside of the junction cable shelf is fixed the order wire relay, which controls the calling lamp used as a signal at night time, when the operators do not continuously listen on the order wires. Below are fitted cord fasteners, resistance spools, two sets of relays, and connectors. The remainder of the relays are fitted on the junction relay rack previously described.

Fig. 10 shows the back of the junction switchboard. A novel feature of this switchboard is the automatic lighting arrangements for use at night time. These are so devised that at night, when a subscriber takes his telephone off its rest, he not only lights his calling lamp and pilot lamp and rings the night bell, but also lights the lamp placed in the continuous reflector on the same section which illuminates the switchboard, so that not only does the operator have a guide to the position on which the call occurs, but a considerable saving in light is effected, as it is unnecessary to leave lamps burning all along the switchboards.

Although the fire risks in an exchange of this type are considerably decreased by the non-inflammability of the materials used, and great care in fusing the various circuits, yet the fire appliances are very comprehensive. A hydrant runs in close proximity to the test and switchrooms, and a movable iron ladder, shown in the right-hand corner of fig. 5, gives access to the roof, from which an iron bridge runs to another wing of the building. Asbestos cloths, chemical engines and sand buckets are also placed in convenient positions.

The operators' quarters are very commodious, consisting of kitchen, dining room, retiring room, and cloak rooms equipped with wire cage lockers specially arranged for the rapid drying of damp cloaks and hats.

Fig. 8 shows the accumulators. The main battery consists of 11 Chloride C.R. type 51-plate cells, with a capacity of 8,430 ampere-hours at a nine-hour discharge rate. The present current output at the busiest part of the day is 160 amperes, and the total daily output from the main battery about 1,300 ampere-hours. The four-cell register battery, used in series with the main battery to get 30 volts for operating registers, is of the R.G. type, with 11 plates and a capacity of 360 ampere-hours at a nine-hour rate.

Fig. 11 shows the power room. Two motor dynamos are installed. The motors are four-polar, and are driven from 200-volt mains; the dynamos are four-pole shunt machines specially constructed for telephone work.

There are 175 segments in the commutator, this high number being chosen with a view to reducing the commutation ripple to a minimum. A fine screw adjustment is also provided on the dynamo brush rocker for the same purpose, and the machines are capable of taking the Exchange load without the battery in shunt, and without any appreciable noise on the lines. The machines have an output of 12 KW. at 30 volts pressure.

Two ringing machines are provided, each having an output of 150 watts at 75 volts, and a frequency of 16·6 cycles per second. These carry also the fast and slow-speed interrupters in connection with the busy-back, automatic ringing, &c.

The common main leads from the battery to the exchange, 180 ft. long, are of novel design, consisting of 520 20-S.W.G. rubber-insulated wires, which are so arranged that both the inductance and skin resistance of the leads, which play such an important part in the production of "cross talk," are rendered practically negligible. It is necessary to fuse the individual wires in this common main, and the fuses for this purpose are shown on the left hand of the power board, each fuse protecting three negative leads.

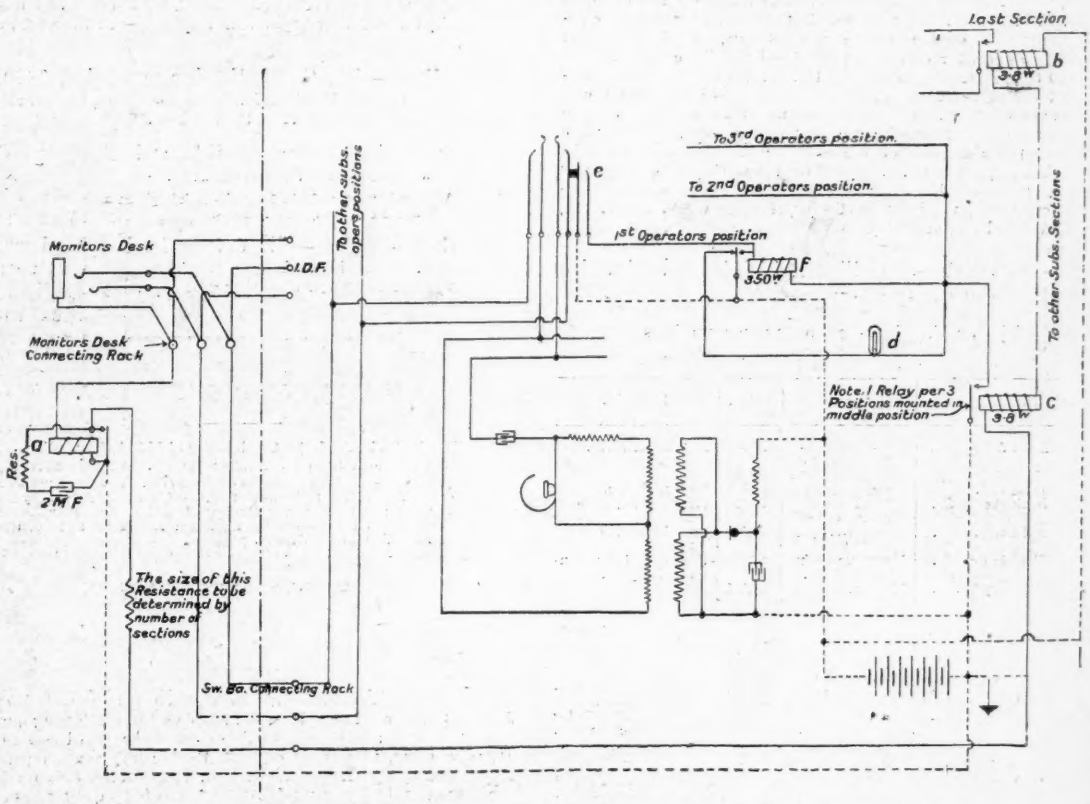


DIAGRAM OF CONNECTIONS OF INSTRUCTION CIRCUIT FOR RELAY SWITCHBOARD.

The whole of the apparatus, cables, &c., was supplied by the Western Electric Co., Ltd., but the work of erection has been carried out by the staff of the National Telephone Co.

We wish, in conclusion, to express our appreciation of the courtesy of the engineer-in-chief of the National Telephone Co., Mr. Frank Gill, in affording us facilities to visit the new Exchange, and to acknowledge our indebtedness to his chief assistant, Mr. W. W. Cook, and Mr. B. S. Cohen, for the information embodied in the foregoing article.

CONTRACTS CLOSED.

(*Continued from page* 18.)

Brussels.—The intense rivalry between Belgian, German and French groups for the contract for the erection and equipment of a large central station at Brussels has now been terminated by the decision of the municipal authorities, which has been arrived at by 30 votes to 8, to entrust the work to the Berlin Allgemeine-Union Co. as represented in Belgium by the Société Belge d'Electricité A.E.G. of Brussels, and the Union Electrique of Brussels. The amount of the machinery contract is £123,616, while the buildings are estimated to cost an additional sum of £51,400. Among the competitors were the Lahmeyer Co., the Parisienne Electrique, and two purely Belgian companies. The latter, according to a statement made by the Mayor of Brussels, did not have a strong financial group in support of their schemes. The successful company has undertaken to complete the works in October, 1906, with a provisional supply beginning next winter, and a regular supply in the winter of 1905.

Cape Town.—The Torque Electrical Engineering Co., of Dalling Road, Hammersmith, have accepted the offers of the following firms for plant and apparatus for the forthcoming Cape Town Exhibition:—

Boilers and engines, 1,500 H.P. ..	Davey, Paxman & Co., Ltd.
Dynamos	Thomas Parker, Ltd.
Arc lamps	Oliver & Co.
Instruments	Johnson & Phillips.

Chesterfield.—A few days ago the T.C. considered tenders for the laying of an electric tramway system 3½ miles in length, from New Brampton to Whittington Moor. The estimate of Mr. R. L. Acland, the resident electrical engineer, for the complete equipment of the scheme was £49,291, and the Council accepted the tender of the British Insulated Wire and Helsby Cables, Ltd., amounting to £41,257 15s. 4d., for the complete equipment of the permanent way, overhead electric lines, undergrcund feeders, and conduits. The contractors undertook to commence the work within three weeks of the receipt of the order, and complete it within three months of commencement. The tender of the British Westinghouse Co. of £2,640 for the electrical equipment of the cars was accepted, as also was that of the Brush Co. for supplying car-bodies and trucks at £3,960 (or, if fitted with radial trucks, at an additional cost of £360).

Hammersmith.—The Electric Lighting Committee has received the following tenders:—

(*a*) For Two Low-Speed Generating Sets (without Condensers).

Name.	Type.	Price.	Remarks.
Siemens Bros. & Co., Ltd.	Cole-Marchent-Morley engine	£20,525	Five alternatives.
Cole-Marchent & Morley..	E.C.C. alternator	21,026	
Electrical Co., Ltd. ..	Musgrave engine	21,787	No condensers.
British Westinghouse Co.	Do. Westinghouse alt.	21,890	94 revs. per minute.
Dick, Kerr & Co.	Musgrave engine	22,194	One alternative tender.
General Electric Co. ..	Musgrave engine G.E.C. alt.	22,458	Less £2,106 for condensing plant.
Wallsend Slipway Co. ..	Wallsend engine	22,710	
Mather & Platt	.. ..	22,864	
Electric Construction Co.	.. ..	23,355	Less £2,430 for condensing plant.
Combe, Barbour & Co. ..	Mather & Platt alt.	24,231	
Witting, Eborall & Co. ..	.. ..	25,270	Less £2,070 for condensing plant.
Musgrave & Co.	Musgrave engine Siemens alt.	25,628	Including £2,277 for condensing plant. Three alternatives.
D. Stewart & Co.	.. ..	25,699	Incomplete.
Lahmeyer Electric Co. ..	Musgrave engine	25,266	Including £2,311 for condensing plant.

(*b*) For Steam Turbines.

Name.	Two turbines.	Condenser plant.	Exciters.	Total.
Willans & Robinson, Ltd.	£12,008	£2,446	£1,046	£15,500
Dick, Kerr & Co., Ltd.	—	—	—	15,961
Willans & Robinson, Ltd.	12,008	3,104	1,046	16,158
Bruce Peebles & Co., Ltd.	12,888	2,416	965	16,219
Siemens Bros. & Co., Ltd.	13,155	2,492	1,031	16,678
Howdens, Ltd.	13,500	2,500	1,130	17,130
Richardsons, Westgarth & Co., Ltd. (accepted for one turbo-generator at £7,270 and condensers at £3,200)	14,540	3,200	967	18,707
British Thomson-Houston Co., Ltd. (accepted for one turbo-generator at £7,272 10s., and exciter plant at £740)	14,545	2,072	740	17,357
Ditto. Ditto. (alternative)	14,545	2,814	740	18,099
Ditto. Ditto. Ditto.	14,545	3,251	740	18,536
Brush Electrical Engineering Co., Ltd.	15,000	2,110	619	17,729
C. A. Parsons & Co.	15,050	2,416	890	18,356
British Westinghouse Electric and Manufacturing Co., Ltd.	15,186	2,512	772	18,470

Cardiff.—The tender of Messrs. Cowans, Ltd., Manchester, of £783 for the supply of a switchboard at the proposed Docks sub-station has been accepted by the Electric Lighting Committee. Tenders for cooling towers and condensers were referred to another committee.

Glasgow.—Messrs. W. McGeoch & Co., Ltd., have received the contract for all the electric fittings for the King's Theatre, Glasgow, which is being built from the designs of Messrs. Frank Matcham & Co. Messrs. McGeoch have fitted up many other theatres for the same firm, and they have several very important ship fittings contracts in hand at present for other firms.

India.—*Indian Engineering*, of June 4th, said that four of the tenders for the installation of electric light and electric punkah-pulling, Mian Mir Cantonment, were under the consideration of the Director-General, Military Works.

Lagos.—The Crown Agents for the Colonies have just placed with Messrs. Mather & Platt, Ltd., an order for a small alternator for Lagos. This machine will be direct coupled to a Belliss engine running at 430 r.p.m., will give an output of 60 kilowatts at a pressure of 1,000 volts with a frequency of 80 cycles per second, and will be provided with a direct-coupled exciter.

London.—The Metropolitan Water Board has placed an order with the Magneta Co. for the installation of electric clocks at the new Central Offices at a cost of £130.

Melton Mowbray.—The U.D.C. has accepted the tender of the Electric Light Co., amounting to £325 per annum, for street lighting during the next five years.

Middlesex.—The County Council has accepted the tender of the Electric Construction Co., at £892, for dynamo and engines (Howden's) for the new asylum at Napsburg—12 firms sent in 70 tenders.

West Ham.—The Corporation has accepted, at £320, the tender of the District Electric Co., Wolverhampton, for the electric wiring and fitting of West Ham Park School.

Wigan.—The Corporation E.L. and Tramways Committee has accepted the following tenders:—

British Westinghouse Co., Ltd., 12 single-deck bogie cars.
Callender's Cable Co., Ltd., feeder cables.

Southend-on-Sea.—The Corporation has placed an order with Messrs. S. Rawlinson & Sons, Blackburn, for a motor-driven tower wagon of the screw elevating gear type.

FORTHCOMING EVENTS.

Friday, July 1st (and Saturday).—Continuation of M.E.A. Convention.
Thursday, July 7th.—At 8.30 p.m. Röntgen Society. Annual general meeting.
Saturday, July 9th.—Junior Institution of Engineers. Visit to Dover to inspect the S.E. & C.R. turbine steamer, the *Queen*; the Admiralty Harbour works; and the Dover Harbour Board works. Reception by the Mayor and Mayoress in the Town Hall in the afternoon. Train from Victoria at 9.55 a.m.

NOTES.

Municipal Accounts.—In the House of Commons on June 23rd, Sir Gilbert Parker had placed the following question upon the paper:—"To ask the President of the Local Government Board whether, in accordance with the recommendation contained in Clause 9 of the Report of the Joint Select Committee on Municipal Trading, he has invited a conference of representatives of the Institute of Chartered Accountants, the Incorporated Society of Accountants and Auditors, the Institute of Municipal Treasurers and Accountants of England and Wales, the Society of Accountants (Edinburgh), and the Scottish Institute of Accountants (Glasgow), to discuss the question of prescribing a standard form of keeping accounts for all municipal or other local authorities as therein set forth; or whether he has otherwise entered into communication with the various bodies mentioned in the clause, and if such conference has not been convened or communication taken place as to its being convened, when such conference will be convened, or what other steps will be taken to obtain a standard form of accounts." Mr. Long, in reply, said that he had received communications from some of the bodies mentioned in the question offering to co-operate in the consideration of this matter. No conference had taken place: but he had been giving attention to the practicability of a standard form of accounts of local authorities being prescribed, and was disposed to think that the best course would be to appoint a departmental committee to inquire into the system upon which the accounts should be kept.

Will.—Mr. Arthur Le Neve Foster, managing director of Davis & Timmins, Ltd., whose death we announced a few weeks ago, left property valued at £14,748.

Gas Turbines.—Our attention has been drawn to a Patent Specification, numbered 5,011, 1902, in which descriptions and drawings of various proposed improvements in "rotary fluid pressure engines" are given. The inventions are those of Mr. C. O. Deutschmann, of 34, South Hill Park, Hampstead Heath, London. We understand that similar patents have been obtained in the United States and Germany, and that experiments are in progress in this country under the ægis of at least one important firm; and therefore, although the methods outlined in the specification appear crude, if not impracticable, we mention the facts for what they are worth.

The North-Eastern Electrification Completed.—From to-day the full service of electric trains is to be run on the 37 miles of railway in the neighbourhood of Newcastle. Sir George Gibb, the general manager, has thus made good the promise he gave when the first section of the lines was opened for electric working in April last—namely, that the whole work should be completed by June 30th.

A German Storage Battery Syndicate.—It is reported that the Berlin Accumulator Works Co. is obtaining control of the stationary accumulator business by acquiring certain works for the purpose of shutting down and by making agreements with others. Among the latter are mentioned the works of Gottfried Hagen, of Kalk, the Pfluger Accumulator Works, of Berlin, and the Neumuhl Lead Works, while the former class is said to comprise the Gelnhausen Accumulator Works, the Oberspree Works, the Pollak Works, at Frankfort-on-Maine, the Berlin Electricity and Accumulator (late Lehmann & Mann) Works, and the Schulz Works, of Witten.

South African Notes (from our Durban correspondent):—

Durban (Natal).—The new 800-KW. alternator set (Willans & Robinson and Dick, Kerr) for the Durban Corporation has arrived, and the work of erection is being rapidly proceeded with, so as to meet the demand for current.

Mr. M. H. Holwell, of 13, Union-Castle Arcade, Durban, has been appointed sole agent in Natal for the Empire Electrical Co.

Johannesburg (Transvaal).—At a meeting of the City and Suburban Tramway Co., held on May 31st, it was decided to sell to the Town Council the whole of the tramway system and assets for £150,000, excluding cash in hand and cash investments as at January, 1904. The Council's first offer was £125,000. This is to be paid in municipal bills, bearing interest at 5 per cent., by January 31st, 1905.

At a Town Council meeting in Johannesburg on June 1st the additional expenditure referred to in our previous "Notes," was approved of by the Council, and includes £3,458 for general lighting of suburbs, £7,485 to replace overhead mains with underground mains, and £12,640 for re-arrangement of the generating station.

Bulawayo (Rhodesia).—At a Town Council meeting in Bulawayo on June 1st, the Mayor introduced a tramway scheme, but the motion was lost, it being felt that the time was inopportune for such.

Cape Colony.—The unaudited revenue returns of the Cape Colony Telegraph Department show a large deficit for April last. The receipts for April, 1903, were £26,743, as against £22,705 for the past April. During the ten months from July to April, 1904, the receipts were £201,533, as against £262,155 for the ten months of the previous year.

Another correspondent writes:—

Pretoria.—The Pretoria Lighting Co. are in future supplying current both night and day.

Boksburg.—A special meeting of the T.C. was held on June 3rd, for the purpose of considering tenders for the electric lighting of the town. Mr. E. H. Gellender, of Germiston, was, however, the only tenderer, and the scheme and tender were referred to the consideration of the Works Committee.

Greater Johannesburg.—At a special meeting of the T.C., the following recommendation of the Tramways and Parks Committee was agreed to without discussion and without a negative vote:—"That an additional capital expenditure of £27,868 be sanctioned for the purpose of providing for the inclusion in the general lighting scheme of the townships of La Rochelle, Rostienville, Ophirton, Booysens, Tunffontein, Forest Hill, Vrededorp, Kensington, Auckland Park, Richmond, and Melville.

Rhodesia.—Electric light is being installed in the Victoria Falls Hotel, which has just been constructed near the famous cataract.

Kroonstad.—The T.C. lately held a special meeting to consider the new tenders for a less elaborate generating station than that for which the previous tenders proved too high. Five tenders were received, and that accepted was sent in by Mr. B. Eastwood at £1,720, the building to be completed in three months.

Bloemfontein.—The city engineer lately reported to the T.C. as follows: "As various questions have cropped up recently regarding the electric light, and as suggestions have been made that the installation is unsatisfactory, I thought it my duty to report to you on the present entire system and to dispose of the erroneous idea that has arisen as to the efficiency of the plant." The Mayor said the demand for light was rapidly increasing, and he was in favour of the new underground cable. Councillor Lambon said the report appeared to be a good as well as an elaborate one, but it had been decided, at the last meeting, to engage an expert. Councillor Bolt contended that the whole of the plant was in order, and the Mayor observed that there was no need for an expert. It had simply been a question of the capacity of one boiler to supply the engine with sufficient steam to give the quantity of electric power necessary. The quality of the coal supplied to the station was very bad. It would be seen from the report that, by using the two boilers, there was sufficient steam to drive the dynamos up to the full capacity. Councillor Hanna proposed, and Councillor Levy seconded, that the decision to obtain expert advice be adhered to. A desultory discussion ensued, during which Councillor Bolt said they had an electrical engine supposed to give 200 KW., and there was a boiler supposed to be 200 H.P. In the result, it was agreed that the matter be left in abeyance till the report of the expert was received.

London County Council.—At the meeting on Tuesday it was decided to lend £25,000 to the Fulham Borough Council for electric lighting works, and £4,300 to the Hampstead Council for the purchase of meters.

The adjourned report of the Highways Committee was brought forward in reference to a proposal to apply for powers to construct tramways over Westminster Bridge and along the Victoria Embankment. It was decided without discussion to make application in this direction in the session of 1905. In a report on the subject by the Finance Committee, it was stated that the linking-up of the northern and southern tramway systems as thus contemplated would be of great public convenience. The Committee further stated that the Highways Committee had resolved not to recommend the Council to promote any new tramway schemes in the next session, nor, excepting one instance, to revive any of the other projects, the promotion of which has hitherto been unsuccessful.

The Council also agreed without discussion to an expenditure of £95,500 in connection with the purchase of the undertaking of the London, Deptford, and Greenwich Tramway Co., under the award of Mr. H. Graham Harris. It was estimated that the working of the lines with horse haulage would result in a considerable deficiency, but in all probability, according to the Finance Committee, they would within a very short period be reconstructed for electric traction.

The Highways Committee reminded the Council of the approval given some time ago to the conduit system for the first section of the northern tramways, and to the use of a slot ⅞ in. in width for the passage of the plough. Since then the Committee had considered the question of increasing the width of the slot to 1 in. This was the width adopted at Bournemouth, and also on several tramway systems in America, and it had, so far as regards the convenience of the general traffic using the thoroughfares affected, been found to work quite satisfactorily. The advantages from such a modification as suggested were two-fold. In the first place, the greater width reduced the danger of using paving materials of a character liable to expansion, and the Council would thus be enabled, to a much greater extent than hitherto, to meet the views of the local authorities and of the public as to a more general use of wood paving, or some similar material, in front of churches and public buildings. In the second place, a wider slot would render it practicable to make certain slight alterations in the type of plough, which would result in greater efficiency in the working of the tramways. The Committee had been in communication with the Board of Trade on the subject, and on their recommendation, the Council resolved to make formal application to the Board for approval of the use of a 1-in. slot on the lines above referred to and to inform the Borough Councils concerned and the North Metropolitan Tramways Co. of the fact.

The Parliamentary Committee referred to the Government Electricity Supply Bill, and recommended the sealing and presentation of a petition against it in order to secure amendments on the same lines as those desired in the Government Bill of last session.

American Chimney Construction.—From the *Engineer*, Chicago, we gather that it is still quite a common practice in America to build chimneys by the aid of exterior scaffolding, and even to-day chimneys may be seen throughout America in which this antiquated method is being employed. During the past half-century no important chimney has, we believe, been so built in this country, but only small structures of too small an internal section to permit of inside winding. Possibly the prevalence of the old method in America was at the bottom of the statement recently made by an American engineer, that American methods of chimney construction were superior to English methods. He even said that the English method was to build from the outside! It costs over £300 to put up a staging for a 250-ft. chimney, which, on the inside system, could be built for an outlay on staging of less than £60. Our contemporary also states that American bricklayers, or, as they are termed, masons, will lay from 1,000 to 1,700 bricks in eight hours. This is a higher speed than is usually attained here, even after taking into consideration the smallness of the American brick, which is the old Dutch brick, about 8 in. × 4 in. × 2½ in., as against the standard English, 9 in. × 4½ in. × 3 in.

Tests of Submerged Coal.—The first tests of the calorific value of submerged coal are about to be made. Ten tons of coal were submerged in lots of two tons each, and 10 tons were stacked in heaps ashore under a tarpaulin. One ton was carefully tested at the time. One crate has now been raised and will be tested against one of the shore heaps, and the two compared with the original ton burned a year ago. The trials are being conducted at Portsmouth, and the remaining submerged coal is, we presume, to be tested from year to year, in order to gain some knowledge of the comparative value of water and air-stored coal.

Third-Rail Fatalities.—Last Saturday evening there was a fatality on the Lancashire and Yorkshire Railway, near Formby power station. The victim was a Welsh Fusilier, aged 22, and he was run over by a train. At the inquest held on Tuesday, it was stated that deceased was not sober when he returned from Southport, and late at night his body was found on the electric railway, cut to pieces by a train. He had crossed the line to reach the camp, despite warnings that it was dangerous. Medical evidence was produced to show that death was caused by the electric current, and had been instantaneous. The body was burnt through. A verdict of accidental death from electric shock was returned.

In the House of Commons last week, Mr. Renwick (Newcastle-on-Tyne) asked the President of the Board of Trade whether arrangements were being made to protect the public and railway servants from contact with live rails between platforms at stations where electric trains stopped or passed through. Mr. Gerald Balfour, in reply, said:—"I understand that on most railways which are being worked electrically the live rail is guarded where it passes through stations. Inquiries have been ordered into two recent accidents arising from electrical working, and when the reports of these inquiries are received the question of the precautions to be taken will be considered." Mr. Renwick said he could give the name of more than one important place where the live rails were not protected.

The recent fatalities have naturally led to a great deal of discussion, and in the *Times* of Friday last appeared a letter signed "Courthope Wilson," from which we extract the following:—"The Lancashire and Yorkshire and North-Eastern Railways have electrified portions of their lines running on the level through thickly-populated districts and have laid rails on the surface of the ground conducting an electric current of sufficient strength to kill any one touching them. Within the last month three lives have been lost by electrocution caused in this way; and the railway companies disclaim all liability and say, forsooth, that the unfortunate individuals who have paid forfeit with their lives were 'trespassing.' Landlords are forbidden to use spring-guns and man-traps against trespassers, and are railway companies to be allowed to inflict capital punishment on those who trespass on their lines? The 'live' rail is raised a few inches above the level of the other rails by the insulators, and the consequence is that any one falling strikes the 'live' rail first. In the stations the 'live' rail is protected by boards on each side rising about an inch above its surface, and if this boarding were extended the whole length of the rail it would prevent accidental contact, which carries death with it. No doubt this would entail some slight extra cost; but the railway companies are adopting electric traction because of its commercial advantages, and the public ought to be protected by making this boarding compulsory. The Lancashire and Yorkshire Railway Bill is now in the House of Lords and has passed its second reading, and Parliament now has an opportunity of inserting the necessary clauses (so far as this company is concerned) to prevent this sacrifice of human life."

Electricity Works Tables:—

ERRATA.

LANCASTER.—The supply voltage is 230 and 460, not 100 and 200.
ST. AUSTELL.—The total capacity of the generating plant is 160 KW.

ADDENDA.

MELROSE BURGH.—Electric Supply Corporation, Ltd. Opened 1904. 225 and 450 volts D.C. Gas producers, 2 Crossley, pressure type. Engines, 2 Crossley. Dynamos, 2 Crompton. Total capacity, 66 KW. A.B.P. battery, max. dis. 70 KW. Callender single bitumen insd. cables laid solid. Total connections (June 16th, 1904) 1,036 8-C.P. Private ligh..ng 6d., power and public lighting 3d., sliding scale.

BEXHILL-ON-SEA.—Add 1 B. & W., 1 Belliss-Westinghouse. Total capacity 650 KW. Max. load 326 KW. Tudor battery, max. dis. 58 KW. Private lighting 17,339, public lighting 47 arc, 518 inc., 10 Nernst, motors 20 = 64 H.P., total connections = 20,967 8-C.P. Lighting 7d. and 2d., pr. 3d., arc £26, two 8-C.P. £3, two 16-C.P. £4 12s., two 32-C.P. £8 per ann. Total units sold 358,635.

The Electrical Engineer Volunteers.—The camps of the corps of Electrical Engineers begin this month, and are held each week until the end of August. The corps is unique in its arrangements for the yearly camps. Each man selects the most convenient date for his training, and, as far as possible, is allowed to exercise a choice of place. The plan has many advantages. Owing to the number of camps each year—some 17 or 18—the number of men at any station at once is comparatively small; each member secures a most efficient training, and at the same time has a very enjoyable outing. Thus the highest efficiency is maintained without interfering with the convenience of the men. The work consists of coast-defence work, including searchlights and submarine mining. Camps are held at most of the southern coast R.E. stations—this year at the Isle of Wight, Weymouth, Falmouth, Plymouth, Portsmouth, Sheerness, Felixstowe, Gravesend, and, it is hoped, Dover and the Scilly Isles. Some of these are mobilisation camps. An Easter camp was also held this year at Weymouth, to meet the convenience of men unable to get away in the summer. In addition the corps sends a big detachment of men annually to assist in the naval manœuvres, and it hoped they will also attend the military manœuvres this year, in order to work the field searchlights. Between camps instruction goes on at headquarters, the corps being well equipped with service pattern oil engines (stationary and portable), dynamos, searchlights, and complete submarine mining outfit. It is found that the electrical engineers show extreme keenness over their technical work, its character and generally educating and withal interesting nature appealing greatly to them. The corps is recruited largely from students of Cambridge University, Royal School of Mines, Central Technical College, and other engineering colleges, also from men actually employed in electrical works.

There are several sub-stations in different parts of the country at which members can receive technical instruction; also week-end classes are held at headquarters, for which the country members come up to town. The chief outlying stations are at Cambridge, Winchester, Chelmsford, Loughborough and Woolwich.

Mr. Hornsby has just presented the corps with a 1-H.P. engine, which it is intended that men shall take apart and build up for themselves, so that they may know all the inner workings of an oil engine.

This year very successful night manœuvres were held at Wimbledon and Hampstead Heath, the portable searchlight projectors used by the corps at the front being called into service.

Under the command of Col. Crompton, C.B., the future of the Electrical Engineers looks very promising.

Compulsory Running Powers.—It is reported that a meeting of representatives of the Manchester, Glasgow, Newcastle-on-Tyne, Sunderland, and Cardiff Corporations, and the London County Council, was held at the Westminster Palace Hotel on Monday to consider the question of giving to outside companies compulsory running powers over municipal tramways, in connection with the Tyneside Tramways Bill, the consideration of which was to come up in the House of Commons yesterday. Reports were received of the action taken and the support promised by members of Parliament for the rejection of the objectionable clauses, and a draft circular to M.P.'s was agreed upon. Preparations were also made for a larger conference to be held on Wednesday.

On Tuesday a deputation, consisting of the members for Newcastle-on-Tyne and several Parliamentary friends who support their view, had an interview with the President of the Board of Trade (Mr. G. Balfour) and Mr. Bonar Law on the subject of compulsory running powers with reference to the provisions sought in the Tyneside Tramways Co.'s Bill in connection with the Newcastle Corporation tramways. The Press Association announced that the Government would yesterday leave the point at issue to the free and unfettered judgement of the House of Commons.

Electricity in Mines.—At a meeting of the Midland Counties Institution of Engineers held at Nottingham on Saturday, Mr. William Hay read a paper on the subject of "Electrical Appliances in Mines." He described in detail the three-phase electric haulage plant at Shirebrook Colliery, which, he said, was put to work in August, 1901, and had worked on an average 18 hours per day and five days per week since, and the cost of repairs for the two years and eight months' running was nil. In that period the amount of coal brought from the workings to the shaft by this motor was 1,042,606 tons, through an average distance of about 1,890 ft. Mr. William Maurice, of Hucknall, commented on the proposed rules for the installation and use of electricity in mines, suggested by the Departmental Committee appointed to inquire into the subject. He considered the interests of safety could be met in a simpler way than by the multiplication of special rules under the Coal Mines Regulation Act, and submitted that it was the legitimate function of a representative body of mining engineers to draft such precautions as might be necessary and to modify them from time to time in order to meet changed conditions.

Institution of Electrical Engineers' Conversazione.—The annual conversazione of the I.E.E. was held on Tuesday evening last at the Natural History Museum, which was, as usual, illuminated with electric arc lamps and suitably decorated. The President, Mr. R. Kaye Gray, and Mrs. B. Hopkinson, as well as the President-elect, Mr. Alexander Siemens, Mrs. Siemens, and members of Council, received the guests, who numbered nearly 1,500. Among those present were: Lord Kelvin, Col. Sir H. A. Yorke, Col. Sir B. Scott, Sir H. Mance, Sir J. I. Thornycroft, Sir W. Ramsay, Sir J. H. Bergne, Sir W. H. Preece, Sir Charles Tupper, the Hon Sir A. R. Jelf, the Hon C. A. Parsons, Col. J. K. Trotter, Major-Gen. R. Wace, Major-Gen. Webber, Col. R. E. Crompton, Profs. Ayrton, Armstrong, Thompson, Sumpner, Callendar, Everett, Robinson, Smith, and Kennedy, the Mayor and Mayoress of Colchester, Messrs. Patchell, Kingsbury, Mordey, Hammond, and many other distinguished engineers and scientists.

The entertainment provided was, as usual, excellent. The string band of the Royal Engineers performed a programme of music in the Central Hall, under Lieut. J. Sommer, M.V.O., and the Westminster Abbey Quartette sang part-songs, glees and madrigals appropriately in the Bird Gallery. Everyone seemed pleased, and the function passed off with unalloyed success.

Electrical Accident in a Coal Mine.—The *Manchester Guardian* says that three colliers, named George Dixon, Joseph Cookson, and Edward Burge, were working with an electric coal-cutter at the Newland Collieries, Normanton, on Saturday, when an electric coil fused and an explosion occurred. All three men were seriously burned, and were removed to the Clayton Hospital, Wakefield, in a critical condition.

Society of Arts.—The annual conversazione was held on Monday evening in the gardens of the Royal Botanic Society at Regent's Park. Upwards of 2,000 persons were present. Sir William Abney, chairman of the Council, received the guests.

Dust Firing.—The second report of the Royal Commission on Coal Supplies shows that a good deal of small coal is never taken out of the mine. The duff, as the really very small coal is termed, will only burn at a very slow rate on a grate, and necessitates large boiler grates to burn sufficient to raise much steam. At one place one man is employed to shovel away dust as fast as another man shovels duff upon the fire. Any amount of duff could be contracted for at 1s. per ton. This small stuff evidently only requires the finishing operation of grinding fine to enable it to be employed in dust firing. Is this Welsh anthracite sufficiently easy of ignition as dust to permit of this system of firing? There is, possibly, no reason why dust fuel should not be a success with suitable boilers and suitable dust collecting chambers.

The Terry Steam Turbine.—A new steam turbine has been constructed by Edward C. Terry, of Hartford, Conn. It is very similar to the well-known turbines of Riedler-Stumpf. The steam streams from conical nozzles tangentially to the moving wheel, that consists of two steel plates, between which vanes, also of steel, are placed. Reversing blades are applied, so that velocity staging is attained. A model of 30 H.P. was built, the moving wheel having a diameter of 2 ft., and making 2,600 r.p.m. The steam consumption was, at a boiler pressure of 145 lbs. per sq. in., 32 lbs. per B.H.P. per hour when worked non-condensing. An interesting item is that through the application of a second series of nozzles the turbine is capable of revolving in a contrary direction.

Liverpool Engineering Society.—About 60 members of the Liverpool Engineering Society visited the works of the British Westinghouse Co., at Trafford Park, on Wednesday of last week.

Appointments Vacant.—Assistant for electricity and magnetism lecture classes at Battersea Polytechnic (£130); rolling stock superintendent for the L.C.C. at £400; shift engineers and sub-station attendants for the Wakefield and District Light Railway Co.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—At Worcester on June 23rd the Electricity Committee granted a day's holiday to all that could be spared from the staffs of the two generating stations to play a cricket match at Powick. After a very enjoyable game the "new station" won by 40 runs. For the new station, Careless, Pacy, and Gardiner batted well, whilst for the losers, Jones made top score. Birrell and Gardiner captured all the wickets for the winners, the former in the first innings taking six wickets for nine runs. For the losers Knott and Wood bowled exceedingly well. The weather was all that could be desired, and the company adjourned to the village hostelry, where luncheon had been provided by the "chief," Mr. SUTHERLAND. At the termination of the match Mr. Sutherland presented the winning team with a handsome silver cup, which is to be played for each year.

The Carnarvon T.C. has appointed Mr. PRICE WHITE, of Bangor, as consulting engineer on the E.L. scheme, at a fee of 100 guineas.

The Epsom U.D.C. has increased the salary of the electrical engineer from £225 to £250 per annum, and that of the chief assistant from £104 to £120 per year.

Mr. CUTHBERT W. MOORE, the town electrical engineer of East London (Natal), has been laid up with enteric fever. He was making satisfactory progress when the mail left.

Mr. GWILLAM has received an appointment at the Crewe Corporation electricity works.

Electric Tramway Officials.—Mr. WITHYCOMBE, clerk of works to the West Ham electrical undertaking, has been promoted to the position of superintendent of the tramways overhead equipment.

The Stockport Electric Tramways Committee has appointed Mr. JOHN GALLOWAY, of Blackburn, as car-shed foreman. There were 80 applicants for the post.

Mr. JOHN BRINDLE, manager of the Bury, Rochdale and Heywood Tramway Co., has been appointed general manager of the Paisley district electric tramways.

The permanent way engineer of the Manchester tramways, Mr. R. C. BULLOUGH, has been appointed manager of the Colchester borough tramways at £300 per annum.

General.—We refer briefly in our leading columns to the fact that the name of Mr. A. W. HEAVISIDE was in the list of the King's Birthday Honours. The commencement of Mr. Heaviside's career as an electrical engineer dates back to the year 1861, when he took charge of the interests of the Universal Private Co., at Newcastle-on-Tyne. He was transferred to the Post Office service at Newcastle-on-Tyne when the Government acquired the telegraphs in 1870, and in 1878 he was appointed superintending engineer for the counties of Northumberland and Durham, which position he still holds. During his long period of service many developments have taken place under his supervision, notably the establishment by the Post Office of a telephone exchange at Newcastle-on-Tyne, the development and continued success of which is largely attributable to the active personal interest which Mr. Heaviside has always taken in telephonic questions. The acquisition of the trunk lines by the Post Office was another undertaking which called for the exercise of careful organisation and expert engineering skill. In addition to carrying out his official duties with credit to himself and to the Post Office, Mr. Heaviside has always taken a wide general interest in the whole subject of electrical engineering. In 1899, when a local section of the Institution of Electrical Engineers was formed, Mr. Heaviside was appointed its first chairman. He delivered his inaugural address in the following year, and still remains one of the most active members of the council of the local section. He is the doyen of the electrical engineers in the north-east of England, and we feel sure that his professional brethren inside and outside of the Post Office Service will agree in thinking that the distinction, which has just been conferred upon him, is not only very appropriate, but thoroughly well deserved.

On 16th ult. Mr. J. R. W. BOND, of the electrical department of the Vulcan Boiler Insurance Co., was married to Miss Margaret Jessie Calvert, at Emmanuel Church, Didsbury.

We are asked to state that Mr. G. RYMAN, manager to the Manchester branch of Messrs. Vandam, Marsh & Co., Ltd., severed his connection with his firm at the end of June, and contemplates starting business in Manchester on his own account.

Our readers, we feel sure, will join us in expressing deep sympathy for Prof. JOHN PERRY, F.R.S., in his sad bereavement through the death of his wife. Mrs. Perry, who was a daughter of the late Thomas Jowitt, of Sheffield, passed away suddenly on Saturday last, June 25th, at Wendover, at the age of 56.

Mr. E. L. JOSEPH has resigned the position of general manager of the Consolidated Electrical Co., Ltd., and his address for the present is Ferrybridge House, Clifton Gardens, Maida Vale. Mr. Joseph had been with the Consolidated Co. since it took over the business of Williamson & Joseph, and his connection with the latter firm and its predecessors, both as manager and partner, dates back for 15 years. He was early in the field as a manufacturer of switchboards and accessories. The Consolidated Electrical Co., Ltd., ask us to state that all branches of their business will be continued on exactly the same lines as heretofore, under the active management of Mr. L. Redmayne, lately works manager, and all communications should be addressed to Northampton Works, Canonbury, N.

The marriage was solemnised on the 16th ult., at St. George's, Hanover Square, of Mr. CHARLES RICHARD DELEBERE, youngest son of Mr. George Edward Pritchett, of Oak Hall, Bishops Stortford, to Jacintha Muriel Laura, youngest daughter of James Arrowsmith, of Buxton, formerly of Brooklands, Cheshire. The bridegroom is one of the managing directors of Pritchetts & Gold, Ltd., of storage battery fame. A reception at the Langham Hotel followed the ceremony. The honeymoon is being spent in Guernsey.

On the 27th ult. Mr. R. HAROLD PIPER was presented by the staff of the Folkestone Electricity Supply Co., Ltd., with a kit bag on the occasion of his leaving to take up the position of secretary to the Guildford Electricity Supply Co., Ltd.

A dinner was given in honour of SIR WM. H. WHITE, the president of the Institution of Civil Engineers by the council and officers of the Institution on Tuesday night. It took place at the Grand Hotel, and among those present were Sir Guilford L. Molesworth (in the chair), Lord Kelvin, Sir Benjamin Baker, Prof. Sir James Dewar, Sir William H. Preece, Sir J. Wolfe Barry, and Dr. Kennedy, a number of whom subsequently looked in at the conversazione of the Institution of Electrical Engineers.

Mr. JOHN HESKETH, electrical engineer to the Postal Department in Queensland, has been appointed by the Federal authorities to visit the St. Louis Exhibition, with a view to inspecting the telegraphic and telephonic apparatus exhibited.

Mr. WALTER P. ADAMS, M.I.E.E., of 35, Queen Victoria Street, E.C., notifies that on June 24th he removed to new offices at 28, Victoria Street, Westminster, S.W.

The Hammersmith Guardians received 14 applications for the appointment as electrical engineer, to prepare specifications in connection with, and to superintend the carrying out of, the electric installations at the workhouse and infirmary buildings now in course of erection at Wormwood Scrubbs, Shepherd's Bush, W. The two selected for attendance before the Board on Wednesday were: Messrs. J. & J. S. ENRIGHT (3¾ per cent. on the expenditure); Mr. F. J. WARDEN-STEVENS (5 per cent. up to £2,000, and 3½ per cent. above that sum, or at a set fee). Messrs. J. & J. S. Enright were appointed.

NEW COMPANIES REGISTERED.

Sykes & Sugden, Ltd. (81,328).—This company was registered on June 22nd, with a capital of £6,000 in £1 shares, to acquire the premises known as "Spring Place Works," belonging to A. Sykes, in Spring Wood Street, Huddersfield, and the business of an electrical engineer and steeplejack carried on by him at the said premises as "W. D. Berry & Sons," and to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, steeplejacks, erectors of lightning conductors, builders, &c. The first subscribers (each with one share) are:—A. Sykes, Spring Place Works, Spring Wood Street, Huddersfield, decorator; A. Sugden, Woodfield, Brighouse, electrical engineer; Mrs. L.

Sugden, Woodfield, Brighouse; Miss G. Sykes, 74, Fitzwilliam Street, Huddersfield; Miss A. Sykes, 74, Fitzwilliam Street, Huddersfield; E. H. Sugden, Woodfield, Brighouse, cotton spinner; and O. Dyson, George Street, Huddersfield, book-keeper. No initial public issue. The first governing directors are A. Sykes (chairman) and A. Sugden; qualification of governing directors, 2,000 shares; remuneration of governing directors, £208 each per annum. Registered office, Spring Place Works, Spring Wood Street, Huddersfield.

Amalgamated Dry Batteries, Ltd. (81,316).—This company was registered on June 22nd, with a capital of £20,000 in £1 shares, to adopt an agreement with B. Sherman, and to carry on the business of manufacturers and vendors of electric dry batteries and other articles, &c. The first subscribers are:—F. E. de Mattos, 7, Great St. Helens, E.C., gentleman; F. H. Rogers, 16—17, Devonshire Square, E.C., patent agent; A. J. Aitkens, 24, Mark Lane, E.C., Colonial broker; B. Sherman, 16—17, Devonshire Square, E.C., electrical engineer; L. F. Goodricke, Moorgate Station Chambers, E.C., chartered accountant; D. H. Muston, 16—17, Devonshire Square, E.C., electrical engineer; and W. C. Goulding, 49, Finsbury Pavement, E.C., solicitor. No initial public issue. The first directors are F. E. de Mattos and B. Sherman (managing director); qualification, 250 shares; remuneration, £75 each per annum.

Reliance Works Co., Ltd. (81,358).—This company was registered on June 25th, with a capital of £10,000 in £1 shares, to adopt an agreement with Sir H. A. White, and to carry on the business of mechanical, electric and general engineers, manufacturers and sellers of the component parts of bicycles and motor-cars, electro-platers, &c. The first subscribers (each with one share) are:—Sir H. A. White, Kt., 14, Great Marlborough Street, W.: E. F. Briggs, Holmwood, Weybridge, solicitor; C. Knight, 83, Clarendon Road, Putney, S.W., clerk; F. C. Beck, 10, Lausanne Road, Hornsey, clerk; W. H. Bracey, 226, Albion Road, Stoke Newington, N., clerk; M. E. Hamshere, 16, Seaford Road, West Ealing, clerk; and W. F. Parks, 21, Dollis Park, Church End, Finchley, clerk. No initial public issue. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Peterborough Electric Traction Co., Ltd. (74,562).—This company's annual return was filed on May 13th, when 4,000 ordinary and 4,000 preference shares had been taken up out of a nominal capital of £60,000 in 6,000 ordinary and 6,000 preference shares of £5 each. £5 per share has been called up, and £40,000 has been received. Mortgages and charges: £20,000.

Kidderminster and District Electric Lighting and Traction Co., Ltd. (59,972).—This company's annual return was filed on May 4th, when 3,000 preference and 4,700 ordinary shares had been taken up out of a nominal capital of £100,000 in 5,000 preference and 5,000 ordinary shares of £10 each. £10 per share has been called up, resulting in the receipt of £770,000. Mortgages and charges: £15,000.

Frank Suter & Co., Ltd. (57,193).—This company's annual return was filed on June 6th, when 2,050 preference and 13,404 ordinary shares had been taken up out of a nominal capital of £20,000 in 6,500 preference and 13,500 ordinary shares of £1 each. £1 per share has been called up and paid on 5,454 shares, and 10,000 are considered as fully paid. Mortgages and charges: £6,000.

Oriental Telephone and Electric Co., Ltd. (40,691).—This company's annual return was filed on May 17th, when 179,319 ordinary and 50,000 preference shares had been taken up out of a nominal capital of £300,000 in 200,000 ordinary and 100,000 preference shares of £1 each. £1 per share has been called up on 7,816 ordinary and 50,000 preference shares, resulting in the receipt of £52,828 10s., including £12 10s. paid on 50 ordinary shares. 171,497 ordinary shares are considered as fully paid. Mortgages and charges: Nil.

West India and Panama Telegraph Co., Ltd. (11,116).—This company's annual return was filed on June 7th, when 34,563 first preference and 4,669 second preference shares had been taken up out of a nominal capital of £2,145,630 in 200,000 ordinary, 34,563 first preference, and 10,000 second preference shares of £10 each. £1,275,630 is considered as paid. Mortgages and charges: £80,000.

Western Telegraph Co., Ltd. (6,885 C).—This company's annual return was filed on June 7th, when 207,930 shares had been taken up out of a nominal capital of £2,500,000 in £10 shares. £10 per share has been called up on 180,000 shares, and £1,300,000 has been received. £779,300 is considered as paid on 77,930 shares. Mortgages and charges: £613,955.

County of London Electric Supply Co., Ltd. (34,320).—This company's annual return was filed on June 7th, when 30,000 preference and 40,000 ordinary shares had been taken up out of a nominal capital of £1,600,000 in 80,000 preference and 80,000 ordinary shares of £10 each. £700,000 has been received. Mortgages and charges: £650,000.

Brisbane Electric Tramways Investment Co., Ltd. (67,853).—This company's annual return was filed on June 1st, when the entire capital of £750,000 in 75,000 ordinary and 75,000 preference shares of £5 each had been taken up. £750,000 is considered as paid. Mortgages and charges: £425,000.

Bournemouth and Poole Electricity Supply Co., Ltd. (55,189).—This company's annual return was filed on May 13th, when 12,000 ordinary and 12,000 preference shares had been taken up out of a nominal capital £300,000 in 15,000 ordinary and 15,000 preference shares of £10 each. £10 per share has been called up on 7,500 ordinary and 15,000 preference, and £4 per share on 4,500 ordinary, and £243,10 has been received, including £10 paid on 10 forfeited shares. Mortgages and charges: £120,000.

West Coast of America Telegraph Co., Ltd. (52,114).—This company's annual return was filed on May 21st, when 45,008 shares had been taken up out of a nominal capital of £132,500 in 53,008 shares of £2 10s. each. £2 10s. per share has been called up on 8, and £20 has been received. £112,500 is considered as paid on 45,000 shares. Mortgages and charges: £170,000.

Headley, Ltd., electricians, Truro (78,535) —Issue, on June 1st, of £1,000 debentures, part of series created May 12th, 1904, securing £2,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Bromley (Kent) Electric Light and Power Co., Ltd. (54,127).—An acknowledgement of indebtedness under seal, dated June 6th, 1904, creating £20,000 further debenture stock (making, with £50,000 already created, a total of £70,000, and being supplemental to a trust deed dated July 7th, 1902) has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: F. T. Metcalf, 9, Great St. Helens, E.C.; and W. R. Davies, 10, Moorgate Street, E.C.

British Electric Calibrated Fuse Co., Ltd. (78,488).—Issue, on June 6th, of £300 debentures, part of series authorised December 6th, 1903, securing £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. Lang, 137, Fenchurch Street, E.C. No trustees. Previously issued of this series: £1,350.

Moelline Co., Ltd., electrical engineers, London.—Issue, on June 1st, of £125 debentures, part of series authorised March 29th, 1904, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital (if any). No trustees. Previously issued of same series: £12,125.

ELECTRICITY SUPPLY ACCOUNTS.

Stepney Municipal Electricity Supply.

We give herewith the returns of the Stepney electrical department for the year ending March 31st last, the fourth complete year of working. It will be noted that the output is a rapidly increasing one, and that as a result of the improved revenue conditions, some £12,793 gross profit has been earned compared with £9,500 in the preceding year.

In connection with the above, it is interesting to note that Stepney is an exclusive user of the demand-indicator system of charging. Out of the appropriation account, some £4,900 was carried to reserve, the balance being utilised for writing off sundry items of capital expenditure.

The prices charged are:—Private lighting, 8d. and 1d. per unit; power, 2d. and 1d. per unit, maximum demand system. The chief engineer is Mr. W. C. P. Tapper.

GENERAL STATEMENT.

For year ending March 31st—	1904.	1903.
Total capital expended	—	—
Number of units sold—		
Private supply	1,802,445	1,321,353
Public lighting	731,066	437,996
Total number of units sold	2,533,511	1,759,349
Equivalent No. of 8-c.p. lamps connected	88,812	58,314
H.P. of motors connected	796	212
Number of public lamps	24 inc. / 331 arc	19 inc. / 170 arc
Maximum load in kw.	1,268	952
Revenue account—		
Gross revenue	£26,617	£19,626
„ expenditure	£13,824	£10,126
„ profit	£12,793	£9,500
Average inclusive price obtained per unit—		
Private lighting	2·69d.	2·80d.
Public lighting	2·10d.	2·20d.

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1904.

Gross revenue	£26,617 = 2·52d.	per unit.
Works and distribution costs (including public lighting)	£11,294 = 1·07d.	„
Total working costs	£13,824 = 1·31d.	„

PROFIT STATEMENT.

Interest on loans	£5,454
Sinking fund	1,150
Sundry items written off	275
Balance carried forward to appropriation account	5,936
Balance brought forward	— 22
Gross profit	£12,793

South Shields Municipal Electricity Supply.

This undertaking for the period under review shows a marked improvement on the results obtained during the previous term. Despite an increased output of some 13 per cent., working costs are only some £146 + £338 increased rates, or £484 higher, and this creditable result is reflected in the improved financial position of the concern. We gather that the department may shortly benefit from a tramway load, as also from the establishment of an adequate reserve fund, if the engineer's remarks are rightly appreciated.

The prices charged are:—Private lighting, 7d. and 2d. maximum demand, 5d. to 3d. per unit sliding scale; power, 2d. per unit. The chief engineer is Mr. J. H. Cawthra.

GENERAL STATEMENT.

For year ending March 31st—	1904.	1903.
Total capital expended	£149,356	£145,815
Number of units sold—		
Private supply	848,109	759,600
Public lighting	451,180	389,365
Total number of units sold	1,299,289	1,148,965
Equivalent No. of 8-c.p. lamps connected	53,837	47,674
Number of public lamps	432	314
Maximum load in kw.	909	829
Revenue account—		
Gross revenue	£17,166	£15,717
„ expenditure	£6,601	£6,117
„ profit	£10,565	£9,600
Average inclusive price obtained per unit—		
Private lighting	3·97d.	4·06d.
Public lighting	1·66d.	1·76d.

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1904.

Gross revenue	£17,166 = 3·17d.	per unit.
Works and distribution costs (including public lighting)	£4,184 = 76d.	„
Total working costs	£6,601 = 1·21d.	„

PROFIT STATEMENT.

Interest on loans	£4,869
Sinking fund	4,070
Balance carried forward	1,604
Deficit on Quay property	22
Gross profit	£10,565

CITY NOTES.

Thomas Parker, Ltd.

THE directors' report for the year ended April 30th, 1904, reads as follows:—

After writing off the various depreciations, as in former years, the balance standing to the credit of profit and loss account is £1,410 3s. 9d. The directors propose to carry the whole of this forward to next year's account. The diminished profits are the result of the general depression in trade and the recent fierce competition in the electrical industry. Large economies have been effected during the year in the methods of construction and works management, and the improved designs have met the requirements of the market. The result of this is, that the works output has been considerably increased, but these advantages are more than counterbalanced by the reduction in prices necessary to secure orders. The directors have devoted constant attention with the managers during the last year to all points where economies could be effected without damage to the quality of the work turned out. The works are full of orders, and the shops are in an exceptionally good position to take the fullest advantage when any improvement in trade shows itself. On the resignation of Mr. Thomas Parker as a director of the company in February last, the directors, pursuant to the articles of association, elected Mr. J. E. Underhill to fill the vacancy. He now retires, and offers himself for re-election. The auditors, Messrs. Allen Edwards & Smith, dissolved partnership in February last, and H. P. Smith, who had charge of the Wolverhampton business, left England and transferred his business to his chief assistant, Mr. W. A. Nelson, incorporated accountant. To meet this casual vacancy, the directors appointed Mr. Nelson to complete this year's audit. He now retires, is eligible, and offers himself for re-election.

The dividend on the ordinary shares for the preceding year was 6 per cent., and for previous years it had ranged from 10 per cent. down to 5 per cent. in 1895. This year the dividend has had to be passed altogether.

Isle of Wight Electric Light and Power Co.

THE annual meeting of this company was held at Ryde last Friday, Mr. F. E. Gripper presiding.

The CHAIRMAN, in moving the adoption of the report, congratulated the shareholders on the very satisfactory progress which had been made during the year. They had had a busy and anxious year in some respects, but now they had practically completed the whole of their undertakings in the island. During the year they had supplied current to East and West Cowes, and had established new works at Ryde. They could judge of the progress of the company from the increase of lamp connections throughout the island. In Ventnor and Bonchurch they had increased from 12,000 to 15,300 lamps; at Sandown and Shanklin the number had gone up from 8,100 to 10,000, and at Newport they had increased from 6,800 to 16,000. Up to the end of last year they had made about 5,000 connections in Ryde and St. Helen's. During the four months of the present year they had made connections, or had received applications therefor, amounting to between 7,000 and 8,000. During the year they had made a profit of £5,640. During the year they had expended about £100,000, £46,000 being spent in Ryde and St. Helen's, and about £28,000 in Cowes.

Col. HAMILTON seconded the motion, and it was carried.

Mr. Gripper was re-elected a director, and Mr. A. H. Crowe auditor.

British Aluminium Co. (Limited and Reduced).

THE report states that the profit for the year 1903 is £34,143, out of which debenture stock interest, charges on stocks of aluminium, &c., absorb £17,276, leaving a balance of £16,877 to be applied in reduction of the debt balance of £22,358 brought forward, of which consequently only £5,480 remains. To this has to be added £79,983, the amount of the suspense account in last year's balance-sheet, which the board has now decided to write off; and also a sum of £8,374, part of the depreciation on investments which the board has not felt justified in continuing to value at cost. The debit balance, therefore, stands at £93,838. The writing of £9 per share off the 10,000 ordinary shares of the company, which was only sanctioned by the Court of Chancery after the accounts for the year were closed, will dispose of £90,000 of this balance, leaving £3,838 to be provided out of current profits. The £10,000 borrowed in January, 1903, in priority to the debenture stock, was all repaid during that year. The board has had the property, buildings, engineering works, plant, and machinery, revalued. The value was reported to be £422,550, and they have accordingly been written down from £584,548 to this figure and the difference taken from the capital reserve fund. The board has applied the balance of this fund, as well as the sum of £8,374 previously mentioned, in reduction of the amount at which certain of the company's investments have hitherto stood. The sales of aluminium during 1903 were considerably larger than in any previous year and they continue to increase steadily. The board has accordingly decided to suspend the manufacture of carbide of calcium and apply the whole of the available power at Foyers to the production of aluminium, as soon as the necessary plant can be erected, this is now in hand. The continuous expansion in the demand for the metal indicates, however, that the *maximum* capacity of output of the Foyers works will before long be inadequate to satisfy market requirements. The board has, therefore, decided to proceed with the development of its Loch Leven water power. Proposals for providing the additional capital necessary for this purpose will shortly be submitted.

J. G. White & Co.

MR. J. G. WHITE presided at the held on the 27th ult., at 22A, College Hill, E.C. He said that, as compared with former years, these results might, perhaps, seem unsatisfactory, for they were, until recently expecting profits as large as in preceding years; but these had not been realised. The bad weather experienced during the summer and autumn of last year contributed to a large extent, also various unsatisfactory general conditions and sundry complications in connection with the carrying out of certain contracts. In one particular instance the estimated cost of carrying out the work was increased by £13,000, due to the causes named, and on this contract the company met with its first substantial loss. In another instance, the financial embarrassment of a client, for whom they were carrying out a large contract, resulted in the estimated profit not being realised. Considerable difficulties were also met with, owing to delay by manufacturers in the delivery of material. This resulted in delayed completion of the work, and consequent increased cost to the extent of some thousands of pounds. Another cause was the deferring, by reason of the financial depression prevailing, of work which would probably be secured later. He did not think it likely that the conditions referred to would recur, and in the experience of the American business a similar reduction of profits by excess costs had happened in only one year out of the 17 of existence. During the 2½ years since their first dividend, which was at the rate of 6 per cent. on the preferred shares only, they had with the dividends now recommended, paid on both preferred and ordinary shares an average rate of 7·6 per cent., and had built up a reserve fund of £20,000. The carry-over had increased from £3,649 to £11,655, representing, with the reserve fund, accumulated earnings during the 2½ years of over £28,000. In addition, the position of the company amongst engineers and contractors has been strengthened by its having carried out many important works, notably the construction at Bournemouth, where this company installed the first commercially successful conduit tramway ever built in Great Britain; also the conduit works carried out for the London County Council tramways, the Tooting section of which was the second commercially successful conduit tramway in Great Britain. The conversion of the Brixton cable line to electrical conduit had been successfully completed considerably in advance of the contract time, and the general consensus of opinion was that the company had succeeded in breaking all previous British records for speed and general efficiency in carrying out the work.

Mr. A. N. CONNETT seconded the motion, which was carried unanimously. It was also resolved that a dividend be paid at the rate of 6 per cent. per annum on the accumulative preferred shares, and at the rate of 6 per cent. per annum on the ordinary shares for the year, to February 29th, 1904; and that a sum of £5,000 be transferred to reserve.

A resolution was subsequently passed increasing the capital of the company to £200,000 by the creation of 5,000 preferred shares of £10 (6 per cent.).

New General Traction Co.

THE report for the 12 months ended March 31st last shows that after paying £3,272 for general expenses, £9,294 for debenture interest, and £3,511 for interest on loans, there is a loss of £6,659. Deducting this from the balance brought forward, there remains £7,523, which is transferred to a special reserve account. In last year's report it was mentioned that measures were taken to overcome the difficulty which stood in the way of completing the Philadelphia system. Owing, however, to the rigorous weather in the United States, it was not until the spring of this year that work could be resumed, and it is only within a very recent date that the directors have received cable advices that the through rail connection has been completed, so that the whole of the line should soon be open for traffic. The Parliamentary Bill for the extension of the Coventry tramway system was duly passed. A contract has been entered into by which the construction work at Coventry is now being carried out by this company. It is expected that the new extensions will be finished before the end of the year, and the relaying of a portion of the existing old track should be completed shortly afterwards. To enable the company to carry out these important works, to complete the Philadelphia system, and to provide for the general purposes of the company, an issue has recently been made of £80,000 4 per cent. prior lien debentures, of which £60,000 has been subscribed at 97½ per cent. and allotted.

Leeds Copper Works, Ltd.

THIS company's meeting (held at Salisbury House, E.C.) was presided over by Mr. J. H. Duncan.

The CHAIRMAN, in moving the adoption of the report, said he did not want them to go away with the impression that, because the past year's working showed a loss, there was anything in the figures to cause dismay. In regard to the loss of £13,000 appearing in the report as the net trading result of the year 1903, they had been paying for their footing in a very important trade, notwithstanding the fact that the board considered the loss might have been reduced, provided certain things could have been foreseen as regarded the management of the company. Referring to the rearrangement of the management, he emphasised the importance of a firm control at their works, and the necessity of economy. This was now being carried out by their new manager, Mr. Jobling. The directors considered that the company had now survived the worst, and that it

had turned the corner. A reconstruction of the capital would be necessary within the next year or so, and when that came the question as to whether the new capital was £13,000 less or £13,000 more would not then be of vital importance.

The Marquis D'HAUTPOUL seconded the motion, which, after discussion, was carried.

Electrical Power Storage Co.—The directors recommend a dividend at the rate of 6 per cent. per annum on the ordinary shares for the year ended May 31st.

British Electric Traction Co.—The report for the year ended March 31st states that in the profit and loss account the total amount for appropriation, including £24,912 brought forward, is £274,730. After providing for debenture interest, preference dividend, and interim dividend at the rate of 6 per cent. per annum on the ordinary shares, there is a balance of £78,139; the directors recommend a dividend at the rate of 6 per cent. per annum on the ordinary shares for the half-year ended March 31st, £38,148 being carried forward. Some fuller details from the report will appear in our next issue.

City of London Electric Lighting Co.—The board has declared the following dividends "on account" of the distribution for the year ending December 31st, 1904:—On the preference shares, 6s. per share; on the ordinary shares, 5s. per share, payable, less income-tax, on the 14th inst.

Stock Exchange Notices.—The Committee has ordered the undermentioned security to be quoted in the Official List:—British Westinghouse Electric and Manufacturing Co.—Further issue of £116,353 4 per cent. mortgage debenture stock (redeemable).

Telegraph Construction and Maintenance Co.—The directors have declared an interim dividend of 12s. per share.

British Columbia Electric Railway Co.—The *Pall Mall Gazette* says that the British Columbia Electric Railway Co., Ltd., has just absorbed the undertaking of the Vancouver Gas Co. The British Columbia Co.'s report for the current year, which ends on the 30th ult., will not be out until October, but for the 11 months ended May 30th, the net earnings have been £12,500 more than for the corresponding period of 1903. The company has now a lighting monopoly in the area it serves.

Cape Electric Tramways, Ltd.—The directors have declared an interim dividend of 5 per cent.

Eastern Extension, &c., Telegraph Co.—Interim dividend for the quarter ended March 31st 2s. 6d. per share.

STOCKS AND SHARES.

Wednesday Evening.

IN presenting our brief tabular statements to show the effect of the first half of 1904 upon electrical prices, it may be pointed out that the chief feature of the list is their irregularity. Only in the Telegraph section does anything like consistency appear. Investment business on the whole has been more or less erratic during the six months, as is seen in the fact that Consols began the year at 88, fell to 85, and are now about 90, after being somewhat higher. Money has become cheaper in the period, and this factor induced a revival amongst high-class stocks and shares, the effect of which, however, was to some extent counteracted by those numerous fresh appeals for money that the easing of rates encouraged. The practical upshot of the six months upon Electricity Supply shares can be seen at a glance in the following figures:—

Shares.	Dec. 31, 1903.	Now.	Rise or Fall.
Brompton and Kensington..	10½	11	½
Charing Cross	9	7⅞	1⅛
City of London	10⅜	11¼	⅞
County of London	8	8	—
Edmundson's	6¼	5⅞	⅜
Kensington and Knightsbridge	11	12½	1½
Metropolitan	17½	20	2½
Notting Hill	13	14	1
St. James's	15	15	—
Urban	5	4⅞	⅛
Westminster	12½	13	½

Metropolitans, of course, have their own especial reason for strength, and the fall in Charing Cross shares can, perhaps, be traced to a heavy new issue made by the company not long ago. With regard to the other changes, the improvement in Bromptons, Kensingtons, Notting Hill, and Westminsters, is due to the greater appreciation of the attractions which these sound shares offer to the investing public. London Electrics at 1½ are the fraction lower, and Smithfields at 3 have dropped ¼ since the New Year commenced.

Amongs the Railway descriptions, a severe decline in Central London Deferred synchronises with the smart rise in Metropolitan Consolidated and District Ordinary stocks. The tables may speak for themselves:—

Stock.	Dec. 31 1903.	Now.	Rise or Fall.
Central London Ordinary ..	94½	91½	3
" " Preferred ..	100½	102½	2
" " Deferred ..	94½	80½	14
City & South London	48⅝	48	⅝
Waterloo and City	92½	90½	2
Metropolitan Consolidated ..	86	97	11
Metropolitan District	34	38½	4½

It is worth noticing that Central London Preferred has actually advanced 2 points, despite the fall in the Ordinary and Deferred. City and South London has only just lately gone flat, upon further competition in the south-west of London.

After the Railway varieties, the Traction group claims attention, and here the outstanding feature is an almost sensational jump of over 20 points in British Columbia Deferred, brought about by the striking progress that the line is making, backed by constant purchases in a market provided with very little stock. The Preferred is also substantially higher as this list shows:—

Stock or share.	Dec. 31, 1903.	Now.	Rise or Fall.
British Columbia Preferred..	92½	99½	7
" " Deferred ..	80½	101¾	21¼
Brit. Elec. Trac. Ordinary ..	11½	9⅞	1⅝
Calcutta	7	7¼	¼
London United Preferred ..	11½	11½	—
" " Deferred ..	103	105	2
Met. Electric Deferred ..	½	3/16	1/16
Potteries, Ordinary	9	8½	½

British Electric Tractions have fluctuated pretty widely, and at one time fell to 8 upon fears that the interim dividend would be passed. This apprehension has proved groundless, the company declaring a dividend at the rate of 6 per cent. the other day, a reduction of 2 per cent., as compared with that of the corresponding period last year. New General Tractions has picked up from about 5s. to 30s., and Anglo-Argentine Preference at 5⅛ are ¼ better as the result of six months.

Coming to the Telegraph section, a healthier tone has succeeded the Marconi and all-British cable scares. Globe Telegraph and Trust Ordinary, which may be said to reflect this market in themselves, are 10s. higher at 9, but Submarine Cables Trust at 120½, have only an extra point to their credit. Some of the principal changes are here noted:—

Stock or share.	Dec. 31, 1903.	Now.	Rise or Fall.
Anglo Preferred..	93	92	1
" Deferred	8	6¾	1¼
Cuba Submarine Ordinary ..	7⅛	7⅛	—
Direct U.S.	10½	10½	—
Eastern Extension	11½	12	½
Eastern Telegraph	123¾	128½	5
Great Northern	25½	26	½
Indo-European	38½	43½	5
Western Telegraph	12	12¾	¾
National Telephone Pref. ..	102	105½	3½
" " Def. ..	78½	85½	7

After the speculation in National Telephones, it will be observed that the Preferred and Deferred have settled down to considerably firmer prices. Reuter's shares at 7, and West India First Preference at 6¼, have not moved on balance, nor have the Ordinary shares of the latter company, which stand at 8s. 9d. apiece.

Diversity is only what might have been anticipated in the Miscellaneous department, from which a few representative examples are taken as follows.—

Stock or share.	Dec. 31, 1903.	Now.	Rise or fall.
British Insulated	6½	5⅞	⅝
British Westinghouse Pref...	4¾	3½	1¼
Callender's	11½	10	1½
Electric Construction.. ..	1⅝	1⅜	¼
Edison & Swan	¾	⅝	⅛
Henley's	14	12	2
India-Rubber	18½	19½	1
Telegraph Construction ..	35½	37½	2

Not only the Preference shares, but also the Debenture stock of the British Westinghouse Co. has suffered, this last to the tune of 7 points, being now 88½. British Thomson-Houston, at 102, is 2 points down. On the other hand, Babcock & Wilcox shares are ½ up, at 3, although that price represents a fall of £2 in Willans and Robinson, on the unfortunate result of the last completed year, with its source of loss, which is now cut off. Taken altogether, if the past six months might have been better in the case of Stock Exchange prices for electrical descriptions, it certainly might have proved very much worse, and those who hold good securities can look forward to the future with confidence and with satisfaction.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations June 22nd.	Closing Quotations June 29th.	Business done week ended June 29th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —103	99 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½ — 3½	2½ — 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	47 — 50	46 — 49	47	46
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	91 — 93	92¼	91½
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	6⅜ — 7⅛	6¼ — 7	6⅝	..
44,000	Chili Telephone, Nos. 1 to 44,000	25	5 %	6 %	..	4½ — 5½	4½ — 5½	..	..
18,333,300$	Commercial Cable	$100	8 %	8 %	..	175 —185	170 —190 xd	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	93 — 95 xd	94⅜	..
16,000	Cuba Telegraph	10	4 %	6¼%	5 %	7 — 8	7 — 8	7⅛	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
12,981	Direct Spanish Telegraph	10	..	..	..	.. — ..	.. — ..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 —103	100 —103⅝	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	10 — 10½	10 — 10½	10⅞	10⅝
85,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —103	100 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	126 —131	126 —131	131	129
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	89½	89
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	105½	105½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11¾ — 12¼	11¾ — 12¼	12⅛	11⅞
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	107½	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	8¾ — 9¼	8¾ — 9¼	9	8¾
180,042	Do. do. 6 % Pref.	10	..	..	..	13 — 13½	13 — 13½	13⅜	13⅛
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25 — 26	25½ — 26¼	..	..
68,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —103	100 —103	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	42 — 45	42 — 45	..	..
1,988,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	104 —106	105	104
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	85 — 88	84 — 87	85⅛	85
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	12½	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	5⅜	5⅛
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 — 101	97 — 99 xd	..	..
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	101 —103 xd	104½	101½
1,000,000	Do. do. Prov. Certs., 70 % to be paid	..	..	..	..	29 — 31	29 — 31	..	..
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	⅛ — 1⅛	⅛ — 1⅛	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	..	..	6½ — 7½ xd	6½ — 7½	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	117 —122	118 —123	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6½	5⅞ — 6⅛	6⅛	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾ — 5¼	4¾ — 5¼ xd	5⅛	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	102 —105 xd	..	..
15,809	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7 xd	6⅞	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel.	100	..	..	..	97 — 100	97 —100	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	12¾ — 13¼	12¾ — 13¼ xd	13	12¹³/₁₆
75,000£	Do. do. 5 % Debs. 2nd series, 1,500	100	..	..	..	102 —105	102 —105	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 —104	100 —103	..	..
68,321	West India and Panama Telegraph	10	..	..	..	⅜ — ½	⅜ — ½	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6 — 6½	6⅝	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 —103	102	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	90 — 95	90 — 95	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9½ — 10½	9½ — 10	10	9⅞
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10½ — 11½	10½ — 11½	10⅝	10⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	116 —119	115 —118	117	116
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5¼ — 6	5¼ — 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾ — 6	5¾ — 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —105	101 —104 xd	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅞ — 1⅛	⅞ — 1⅛	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	¼ — 1	¼ — 1	..	..
160,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	½ — 1½	½ — 1½	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	73 — 78	71 — 76 xd	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	7½ — 10½	9½ — 10½	..	..
40,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5½ — 5¾	5½ — 5¾ xd	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —108	101 —105 xd	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	92 — 95	90 — 93	94	91
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	102 —105	101 —104	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 82	79 — 82	81	..
1,330,000	City and South London Railway	Stock	2 %	2½%	2¾%	50 — 52	47 — 49	49¼	46½
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	5 %	..	1¾ — 2¼	1¾ — 2¼	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	95 — 98	95 — 98	97⅛	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	⅛ — ¼	⅜ — ⅝	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	¼ — 1½	1 — 2	..	..
44,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 78	72 — 77 xd	..	..
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 79	75 — 79	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2¼ — 2½	2¼ — 2½	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¼ — 9¾	9 — 9¼ xd	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11¼ — 12¼	11¼ — 12¼	11⅝	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	18½ — 19½	19	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
87,580	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3¾ — 4	3¾ — 4	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,850	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	86 — 89	86 — 89	..	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
640,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3⅛%	3⅛%	89 — 92	89 — 92	91½	91

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations June 22nd.	Closing Quotations June 29th.	Business done week ended June 29th, 1904. Highest.	Lowest.
£100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡	..	..	..	⅝— ¾	⅝— ¾	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛— 1⅜	1⅛— 1⅜	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	120 —125	120 —125	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	8 %	10 %	10¾— 11½	10⅝— 11½	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10½— 10⅝	10½— 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	106½	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7½— 8	7½— 8	7⅝	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4½— 5	4½— 5 xd	..	..
40,000	Do. do. 1903	5	..	..	..	4⅜— 5	4½— 5 xd	4⅝	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104 xd	102 —104	..	..
44,436	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5½%	6½— 6⅝	6½— 6⅝	6⅝	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	106 —109 xd	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	11 — 11½	11— 11½	11⅜	11¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip, (iss. at 115) all paid	..	..	..	..	121 —126	120 —125 xd	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	101 —104 xd	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7½— 8½	7½— 8½	7¹¹/₁₆	7⅞
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11 — 12	11 — 12	11⅞	11
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	106 —109	104 —107 xd	108	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5⅜— 6	5⅜— 6	5⅝	5⅞
80,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅞— 5⅞	5⅝— 5⅞	5⅞	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	106 —109	106 —109	108½	108¼
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12%	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1¼— 1⅜	1¼— 1⅜	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	5 3/32	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	93 — 96 xd	93 — 96	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¾%	7½%	8½%	19¼— 20½	19¼— 20½	20⅜	20
71,106	Do. do. 4½% Cum. Pref, 1—71,106, £3 paid ..	5	..	..	..	5⅛— 5⅜	5¼— 5⅜xd	5⅜	..
230,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	109 —113	108 —112 xd	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	96 — 99 xd	..	..
10,863	Notting Hill Electric Lighting	10	6 %	6 %	6 %	13½— 14½	13 — 14 xd	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14¼— 15¼	15	14¼
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	8 9/16	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	96 — 99 xd	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	2⅞— 3⅛	2⅞— 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	1¾%	3 %	3⅞— 4¼	3⅞— 4¼	4⅛	4
80,000	Urban Electric Supply, Ord.	5	..	..	..	4¼— 5	4⅜— 5	4⅝	4 7/16
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4¼— 5	4¼— 5	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12⅞— 13¼	12½— 13¼	13¼	12 9/32
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6¼— 6⅜	6¼— 6⅜	6 7/16	6¼

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, June 29th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	29/-	..
a	,, Oxalic	per cwt.	89/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£21 10	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	5½.	..
a	,, Caustic (76/80%).. ..	per ton	£24	..
a	,, Bisulphate	per ton	£25	..
a	Shellac	per cwt.	220/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	Recovered	per ton	£5 10	..
a	,, Lump	per ton	£6	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	Crystals	per ton	£8	..
a	Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£180	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£48 to £180	..
c	Brass (rolled metal 2" to 12") basis	per lb.	6¼d.	..
c	,, Tube (brazed)	per lb.	8¼d.	..
c	,, ,, (solid drawn).. ..	per lb.	7¼d.	..
c	,, Wire, basis..	per lb.	6¾d.	..
c	Copper Tubes (brazed)	per lb.	9½d.	..
c	,, ,, (solid drawn) ..	per lb.	9¼d.	..
a	Copper Bars (best selected ..	per ton	£69	..

	METALS, &c. (*continued*).		Latest Price.	Week's Dec. or Inc.
g	Copper Sheet	per ton	£69	..
g	,, Rod	per ton	£69	..
e	,, (Electrolytic) Bars ..	per ton	£62	..
e	,, Sheets ..	per ton	£78	..
e	,, ,, Rod ..	per ton	£72	..
e	,, ,, H.C. Wire	per lb.	7¾d.	..
f	Ebonite Rod	per lb.	8/8	..
f	,, Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	4/8 to 4/9½	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	42/6	1d. dec.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£11 15 to £11 17 6	..
g	,, ,, Sheet	per ton	£11 17s. 6d.	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	,, ,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/3½	..
p	,, rolled bars & rods	per lb.	1/- to 1/8	..
p	,, ,, strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	£4	..
c	Silicium Bronze Wire	per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£119 to £120	10/- inc
g	,, Foil	per lb.	1/6	..
n	,, Wire, Nos. 1 to 16	per lb.	1/6½	..
p	White Anti-friction Metals—			
	"White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5⅝d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4¹¹/₁₆d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£25 5	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Br's. Elec. Trac. Co.	Aberdeen	June 26	1,534	+287	4	6,020	+ 1,157	10	—
	Birmingham ..	,, 25	5,479	+119	26	138,871	+ 8,313	3½	—
	Blackburn	,, 24	920	+ 11	13	12,380	+ 899	13½	—
	Blackpool	,, 23	857	—160	12	10,434	+ 531	8½	—
	,, —Fleetw'd	,, 25	690	+ 6	26	9,464	— 771	7½	—
	,, —Lytham	,, 23	456	— 23	24	8,205	+ 5,645	7½	—
	Bolton	,, 26	1,835	— 82	13	23,795	— 186	25	—
	Bournemouth ..	,, 22	1,050	+118	12	13,163	—	10½	—
	Bradford	,, 18	4,671	+1186	11	51,794	+ 9,174	46	—
	Brighton	,, 26	979	+ 32	—	11,476	—	7½	—
	Bristol	,, 24	5,201	+108	—	—	—	38	—
	Devonport ..	,, 17	567	+132	24	11,968	+ 1,902	5	—
	Dudley—Sto'rb'ge	,, 17	883	+ 87	24	19,528	+ 722	18½	—
	Gateshead ..	,, 17	945	+ 49	24	21,135	+ 1,026	10½	+ ½
	Gr'n'k—Pt. Glsgw	,, 17	624	+ 17	24	12,506	+ 641	7½	—
	Oldham—Ashton	,, 17	566	+ 52	24	12,774	— 633	8	—
	Potteries	,, 17	1,730	+309	24	40,826	+ 3,803	29½	—
	Southport	,, 17	343	+ 55	24	7,072	+ 377	5½	—
	South Staffs. ..	,, 17	759	— 89	24	18,704	— 942	21½	—
	Swansea	,, 17	532	+ 65	24	12,180	+ 816	5½	—
	Wolverhampton..	,, 17	406	+ 57	24	8,999	— 221	10½	+8
	Yorks. Wool Dist.	,, 17	640	+347	24	13,700	+ 5,952	6	—
	Miscellaneous ..	,, 17	3,556	—	24	67,362	—	—	—
	Burnley	,, 25	986	+194	—	—	—	10½	+8½
	Burton-on-Trent ..	,, 19	354	—	11½	3,899	—	2½	—
	Cardiff	,, 18	2,490	+258	11	23,157	+ 949	14	—
	Chatham & District	,, 23	665	+ 76	25	15,894	+ 2,065	8 10	—
	Cork	,, 23	525	— 31	25	10,831	— 894	9	—
	Dover	,, 25	252	— 16	25	4,813	— 258	3	—
	Dublin	June 24	5,409	+248	26	118,113	+ 3,140	47	+ ½
	East Ham	,, 25	781	— 23	12	9,502	+ 988	5	+ ½
	Glasgow	,, 25	14,280	+807	4	54,308	— 1,475	71½	+6½
	Halifax (2 weeks) ..	,, 15	3,105	+578	11	16,297	+ 1,073	33	+2
	Huddersfield ..	,, 18	1,312	+182	11	—	—	28	—
	Hull	,, 25	2,152	+289	12	26,178	+ 2,959	13	+2½
	Ilkeston	,, 22	143	— 49	12	1,765	—	3	—
	Ipswich	,, 25	525	—	12	5,969	—	10½	—
	Isle of Thanet ..	,, 25	898	+ 9	25	10,197	— 212	10½	—
	Leeds	,, 25	5,781	—230	—	75,364	+ 4,361	8¼	+2
	Liverpool	,, 18	10,857	+1188	25	248,288	+ 5,685	108	—
	London C. C. ..	,, 18	12,488	+3892	11	130,202	+22,131	8½	—1½
	Manchester	,, 25	12,112	—157	12	146,901	+ 8,460	131½	—
	Newcastle	,, 25	4,989	+657	—	—	—	17	—
	Portsmouth	,, 25	2,313	— 28	—	23,960	+ 2,170	14½	—
	Salford	,, 20	3,494	+ 94	—	47,567	+ 4,594	30	—
	Sheffield	,, 26	4,669	— 10	13	61,773	+ 1,916	33	+5½
	Southampton ..	,, 16	976	—221	—	—	—	9	—
	Southend-on-Sea ..	,, 22	391	+ 59	12	3,786	+ 297	6½	—
	Sunderland	,, 26	1,361	— 44	12	15,630	+ 343	20	+1
	Tyneside	,, 15	868	+ 83	24	7,694	+ 929	8·9	+ ·4
	West Ham	,, 23	1,132	—	17	12,115	—	8	—
	Wolverhampton ..	,, 22	619	+171	—	—	—	7·563	—
	Cen. London Rly. ..	,, 25	6,621	—438	26	178,340	— 3,245	6	—
	City & S. Lon. Rly.	,, 26	2,552	+103	26	76,671	+ 2,545	6½	—
	Dublin—Lucan Rly.	,, 19	130	+ 8	25	2,723	+ 210	6½	—
	G. N. and City Ry.	,, 18	890	— 13	18	16,659	—	3½	—
	L'pool Overh'd Rly.	,, 26	1,721	+ 61	27	41,220	+ 48	6½	+4½
	Mersey Railway ..	,, 25	1,904	+418	25	37,568	+ 7,611	4½	—

* Compared with the corresponding period of 1903.

THE INDUCTION MOTOR DIAGRAM.

By W. PARKER.

As the literature on this subject in the English technical Press is somewhat meagre, it seemed to the writer that the description of a diagram (fig. 1) which, he believes, shows for the first time not only the phases and magnitudes of the rotor and stator currents, but also the various fluxes operating in the motor, would be of some service to those students and electrical engineers who are interested in the induction motor.

It is well known that the Heyland diagram contains slight errors, which, however, are not of sufficient importance to prevent its being used for practical purposes. To anyone approaching the induction motor diagram, however, for the first time, these errors are quite sufficient to render the diagram exceedingly difficult to understand. Another, and a more serious, objection is that the fluxes operating in the motor are not by any means clearly shown. Both these defects are removed in the diagram here given. It has not been the intention of the writer to deal with the question of slip, and the various corrections necessary for copper drop, iron loss and bearing friction, but rather to describe as clearly as possible the various phases and magnitudes of the currents and fluxes, as until these are clearly grasped these corrections only serve to confuse the issue. The usual assumption of very small losses has therefore been made. The fairly justifiable assumption that the fluxes are proportional to the currents producing them has also been taken. This latter supposition is of importance, as any vector in the diagram then represents either current, or the total flux produced by it, at will.

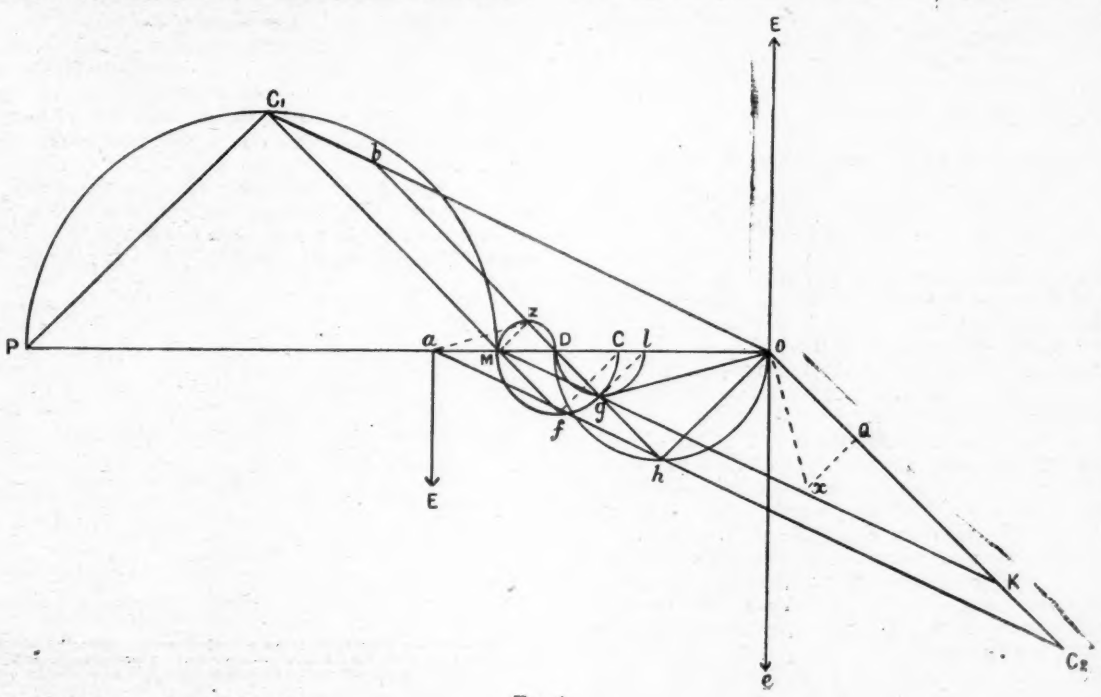


Fig. 1.

No Load Condition.—By applying a known voltage to the stator winding and inserting an ammeter in one of the three phases, we obtain the no-load current, and by means of the well-known formula :—

E.M.F. $= 4{\cdot}0 \times K \times \sim \times$ turns $\times$ flux $\times 10^{-8}$

the flux per pole in the motor ; K being a constant depending upon the shape of the flux curve and the kind of winding employed. As the losses are very small the no-load current can be taken to be all magnetising current and the rotor runs at synchronous speed.

Let O E (fig. 2) represent the applied volts. Since the windings are practically without resistance, there must be an E.M.F. generated in the stator exactly equal and opposite to this, viz., O *e*. The flux producing this voltage, O *e*, is given by the above formula, and is, of course, at right angles thereto ; we, therefore, set it off along O M, as the vectors are assumed to revolve clockwise. O M, to another scale, will also representt he magnetising current, since the flux is in phase with the current producing it.

At this stage it is necessary to make two other measurements on the motor, viz., the leakage coefficients of stator and rotor. Applying again a known voltage to the stator winding and connecting a voltmeter across the open-circuited rotor, we obtain the leakage coefficient of the stator. As the rotor is stationary, this is the ratio of the applied volts to the rotor volts, assuming the same number of turns on both rotor and stator. The reverse process gives us the leakage coefficient of the rotor. These coefficients, which we shall call v, are assumed to be equal, and in the diagram they have been taken at 1·25 in order that the construction may be the more clearly shown ; the leakage coefficient in a commercial machine being of the order of 1·05.

The flux O M on no load is shown diagrammatically in fig. 3, which is a development of the periphery of rotor and stator.

The result of these measurements on the motor shows that for every line produced in the stator by the current O M $\left(1 - \frac{1}{1{\cdot}25}\right)$ or ·2 leaks along the gap, and does not pass through the rotor. The piece M D is, therefore, set off along

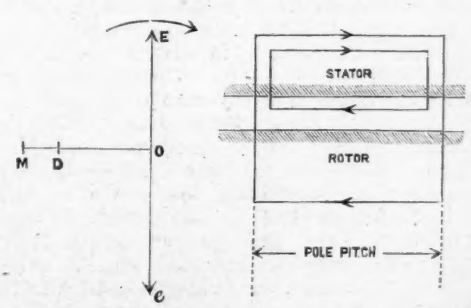


Fig. 2. Fig. 3.

M O (see fig. 1) to represent this leakage flux, the remainder D O being the flux which passes through the rotor. If the rotor circuit be now closed the rotor will run at synchronous speed, and this flux will produce no current in the rotor bars.

Load Condition.—The applied volts O E are assumed to

remain constant. This being so the back volts O *e* will also remain constant, since there is no copper drop; hence the flux O M remains absolutely constant, and is always linked with the stator coils, a portion passing through the rotor, and the remainder leaking along the gap.

Having noted this, load is now put on to the machine. The stator current immediately increases, and comes more nearly into phase with the applied volts O E, for the reason that any current which is doing work must be in phase with the applied volts. This new stator current is represented in

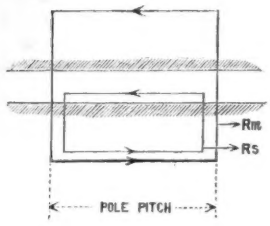


FIG. 4.

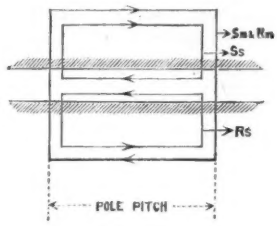


FIG. 5.

the diagram by O C_1. Bearing in mind the assumption already made, this vector will also represent the *total* flux which would be produced by the current, assuming there were no other currents in the machine. Knowing that $1 - \frac{1}{v}$ or ·2 of this flux leaks along the gap, we have C_1 *b* as the stator leakage flux at this load.

The flux O *b* we shall call S_m (stator main) and the flux C_1 *b*, S_s (stator stray). These fluxes are shown diagrammatically in fig. 3.

The next step is to arrive at the rotor current, the hypothetical fluxes due to which are shown in fig. 4, and the combination of the fluxes due to both stator and rotor in fig. 5; R_m signifying rotor main flux and R_s rotor stray.

It is clear from fig. 5 that the flux O M (see fig. 1) must be the resultant of S_m, R_m and S_s, since these are the only fluxes linking the stator bars.

Completing the parallelogram O C_1 M K, therefore, we obtain O K = R_m, the flux which would link both rotor and stator bars were there no stator current. In order to obtain the total rotor flux, however, we must multiply O K by the leakage coefficient, in our case 1·25; we thus obtain O C_2. This is also the rotor current, since the assumption made at the outset was that the *total* flux produced was proportional to the current producing it. It will also be observed that K C_2 is the rotor leakage flux R_s. The vectorial sum of O C_1 and O C_2 is O *f*, the resultant of the currents in the machine.

If the piece C_1 *b* representing the stator leakage flux be now moved parallel to itself until it takes up the position M *g*, and the triangle O M *g* be completed, we obtain O *g*, which must be the resultant of the main fluxes produced by the stator and rotor currents. This can be seen from the diagram, for O *b* = S_m, and O K = R_m.

Although the flux O *g* links both stator and rotor windings, it is not completely effective in producing torque, since it is not at right angles to the rotor current, owing to the fact that the rotor is inductive, or, in other words, has a stray field of magnitude and phase K C_2. If we take the resultant of this leakage flux K C_2 or *g h* and O *g*, the resultant O *h* will be at right angles to the rotor current O C_2, and is therefore the flux producing torque. Another way of looking at the question is to say that the flux O *h* produces the voltage O Q necessary for overcoming any C R drop, which voltage is therefore in phase with the current, and at right angles to O *h*, while the flux *g h* produces an inductive voltage Q *x* at right angles thereto and to the flux *g h*, O *x* being the resultant voltage, which can again be considered to be due to the flux O *g*, to which it must also be at right angles.

O *h*, as we have already mentioned, is completely effective in producing torque for the reason that it is at right angles to O C_2. In order to realise this more clearly, it is only necessary to consider that in the machine itself the *plane* of the rotor coil carrying the current O C_2 must be in phase with the flux which is effective in producing torque; and since the axis of reference of a coil is at right angles to its plane this must be the flux O *h*.

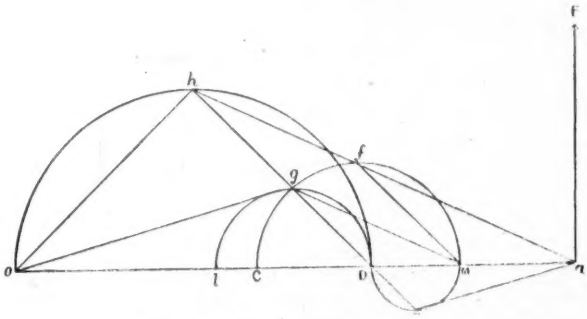
Phases and Magnitudes of the Various Vectors.—The next point to be considered is the way the various fluxes and currents vary in magnitude and phase with varying load.

Since O D is a fixed length (it being $1 - \frac{1}{v}$, or ·8 in our case, of the constant length O M) and the angle D *h* O is a right angle, we know that the point *h* moves on the semi-circle D *h* O. If we now prolong *h f* until it cuts O M prolonged at *a*, we obtain a triangle D *h a*, which is similar to O K M or O C_1 M. Further, by drawing a line *a z* parallel to O *f* we obtain a triangle *z h a*, which is similar to O C_2 *f* or O C_1 *f*. It will be seen, therefore, that *a h* is proportional to the stator current O C_1, *z h* to the rotor current O C_2, *a* D to the no load current O M and *a z* to the resultant of the currents O *f*.

As the vector O C_2 or *z h* varies, we know that the piece K C_2 or D *z* also varies in the same proportion, and since the point *h* moves on a semi-circle, it therefore follows that the point *z* also moves on a semi-circle, viz., D *z* M.

Also, since the stator current *a h* moves on the semi-circle D *h o* the stator leakage flux will also move in a similar manner for the reason that these two quantities are proportional to one another. We know that M D is the stator leakage on no load, M *g* at the load shown in the diagram; we also know that the figure which is intended to show the complete history of the stator leakage must be similar to that showing the stator current, we therefore draw *g l* parallel to *h o*, describe the semi-circle D *g l* and we obtain the phase and magnitude of the stator leakage with varying load.

We have already shown that D *z* moves on the semi-circle D *z m*, but M *f*, which represents the rotor stray flux, will therefore also move on a semi-circle, since it is proportional to D *z*. Drawing *f* C, therefore, parallel to M *z* so that the



Currents.—*a* E = applied voltage; *a* D = no load mag. current; *a h* = stator current (path of *h* = D *h o*); *z h* = rotor do.; *a z* = resultant of S. and R. currents (path of *z* = D *z* M); *a* O = stator current at short circuit; O M = rotor do. do.

Fluxes.—O M = stator flux, constant; M *f* = *g h* = rotor leakage (path of *f* = M *f* C); M *g* = stator leakage (path of *g* = D *g l*); O *g* = flux which links both stator and rotor bars; O *h* = portion of O *g* at right angles to rotor current and producing torque.

FIG. 6.

triangle M *f* C is similar to D *z m*, we obtain the path of the point *f*, *i.e.*, the phase and magnitude of the rotor leakage with varying load. *g h* also represents the rotor leakage flux.

The diagram is now complete, and it only remains to disentangle the useful vectors from among the host of now useless vectors which have been used in its construction. This we can easily do by taking everything included in the region of O *l* C D *z* M *a f h o* and swinging it through an angle of 180°, thus obtaining the diagram shown in fig. 6.

The diagram now wears a familiar appearance to anyone previously acquainted with the subject, and below it is a table giving the significance of each vector.

Stationary Condition.—The most important thing to be observed here is that since the torque flux *o h* has disappeared, the rotor obviously will not revolve, since one of the factors producing the torque has become zero. The cause of the disappearance of the torque flux is due to the increase of the stator leakage and to the fact that the rotor stray has come in opposite phase to the main flux produced by the resultant of the stator and rotor currents; the two together making up the flux O M necessary to balance the applied volts O E.

THE REPULSION MOTOR.

By F. W. CARTER, M.A. Cantab.

(*Concluded from Vol.* 54, *page* 1052.)

THE efficiency curve given takes account of all electrical and magnetic losses, but takes no account of gear, brush and bearing friction or windage, for these present no features peculiar to the repulsion motor. Thus the working efficiency would be somewhat lower than is shown, and more so at high than at low speeds. The rotor efficiency is given by equation (17), whence the loss in the rotor copper. The iron loss is purely an estimate or guess, based on the following considerations. At speeds below synchronism, the iron loss will be greater at lower than at higher speeds for three reasons: First, the frequency of alternation of the rotor flux diminishes from that of the impressed field at starting to zero at synchronism. Secondly, the mean flux diminishes continuously as the speed increases. Thirdly, the distribution of flux, whilst far from uniform at low speeds, reaches practical uniformity at synchronism. The two latter characteristics will be seen immediately by reference to fig. 5, in which is plotted the variation in maximum and minimum flux with change of speed. Above

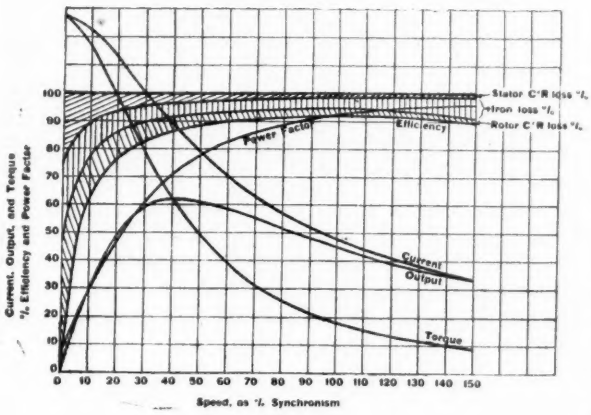


FIG. 4.

synchronism the iron loss might be expected to increase slightly on account of rotor losses reappearing, although the mean flux continually decreases. The stator copper loss was assumed 4 per cent. of the output at the point of maximum output, being taken at other outputs proportional to the square of the current. By adding the losses so obtained to the output at the rotor bars, the input of the motor is obtained, whence the efficiency. Fig. 4 shows also segregated percentage losses at different speeds.

We will finish our mathematical investigations by giving some discussion of the value of q. It would be impracticable to determine this quantity experimentally, with the exact shade of meaning contemplated in the definition.

Let l be the length of the armature core and r its radius at the face. Let λ be the mean length of the magnetic circuit, expressed in terms of the equivalent air path, so that—

$$\lambda = 2 \times \text{air-gap} + \Sigma \frac{\text{length in a section of iron}}{\text{permeability of the iron.}}$$

Referring to fig. 2, the air-gap flux density at the point P is given by—

$$\lambda F_p = 4\pi\, 2\, n \frac{\pi - 2\theta + 2a}{\pi} \times \text{current per circuit.}$$

$$\therefore F_p = \frac{8n}{\lambda}[\pi - 2(\theta - a)] \times \text{current per circuit.}$$

Hence the total flux between θ and $-(\theta - 2a)$ is—

$$2\int_a^{\theta} F_p\, d\theta \times \frac{r\,l}{w}$$

$$= \frac{16\, n\, r\, l}{w\, \lambda}[\pi - \overline{\theta - a}](\theta - a) \times \text{current per circuit.}$$

When the armature current is unity the current per circuit is $\frac{1}{2w}$, since there are $2w$ circuits (assuming a multiple wound armature).

Thus

$$L = \frac{8 n^2 l r}{w^2 \lambda \pi}\int_a^{\pi + a}(\pi - \overline{\theta - a})(\theta - a)\, d\theta$$

$$= \frac{4 n^2 l r \pi^2}{3 w^2 \lambda}. \qquad (25)$$

Let $y\,l$ be the length of an armature turn $= 2\,l +$ length of end connections. Furthermore, let $2\pi r s$ be the area of all the armature slots and k the fraction of this which is occupied by copper, then, ρ being the specific resistance of copper—

$$R = \rho \frac{n\, y\, l}{2w \frac{2\pi r s k}{4 n w}} = \rho \frac{n^2 y l}{\pi r s k}. \qquad (26)$$

Here the outside resistance between the brushes is neglected.

$$\therefore q = \frac{R}{L\, p} = \rho \frac{n^2 y l}{\pi r s k} \cdot \frac{3 w^2 \lambda}{4 n^2 l r \pi^2 p}$$

$$= \frac{3}{4} \frac{\rho\, y\, \lambda\, w^2}{k\, s\, \pi^3\, r^2\, p}. \qquad (27)$$

Let the maximum permissible peripheral speed be—

$$S = r \frac{c\, p}{w},$$

S will be constant for a particular armature construction, and the limiting speed c depends on the requirements. Then—

$$q = \frac{3}{4} \frac{\rho\, y\, \lambda\, c^2\, p}{k\, s\, \pi^3\, S^2}$$

$$= 1{,}000 \frac{y\, \lambda\, c^2\, f}{k\, s\, S^2}. \qquad (28)$$

In equation (28), λ and s must be in the same units, and S is in feet per minute.

We can draw a number of conclusions from equation (28). Remembering always that we have to make q small, we see that it is easier to design the motor for a low frequency than for a higher one, that we should run at a high peripheral speed, that we should carry as much copper as practicable on the armature periphery, whilst keeping the end connections as short as we can, that we should work with as small an air-gap, and as low a density, as practicable. Although q is independent of n, we should naturally use single turn coils between commutator segments, whilst for the sake of good commutation we should probably employ a somewhat large number of segments.

In motors of this class one would naturally expect that satisfactory commutation would be difficult or impossible to attain, in spite of the fact that the armature voltage is low, for the E.M.F. generated in the short-circuited coil is usually almost in quadrature with the current to be commutated, as it is in the alternating current series motor. Nevertheless, it appears that with care the commutation can be made practically satisfactory. One must not seek to improve it, however, by putting a resistance lead between coil and commutator segment, as this would increase q and reduce the efficiency. The Latour and Winter-Eichberg compensated repulsion motors are said to commutate satisfactorily, but whether more satisfactorily than the pure repulsion motor the author has no information.

The formulæ deduced in the course of the foregoing analysis form the greater part of such as are required in the electrical design of these motors, and the skilful designer will have no difficulty in applying them to produce a motor meeting prescribed conditions. It is not proposed, however, to go further into the question of design in this place, for it is probable that the readers of this article have already had enough of the author's methods of calculation.

The simple repulsion motor, the shape of whose speed-torque curve is given in fig. 4, whilst possessing in a general way the characteristics required of a railway motor, would, nevertheless, hardly be suitable for tramway or ordinary railway work. Some use might be made of it for long-distance high-speed work on approximately level track, where

a high rate of acceleration is of little importance, and the changes in train resistance due to grades are partially compensated by the changes of windage due to variation of speed. For ordinary traction work, however, the torque curve approaches the horizontal too quickly; that is, the torque reaches a value which changes but little with the speed before it has become a sufficiently small fraction of the starting torque. This is evident from fig. 4, in which, if the free running speed on the level were synchronous speed, a ½ per cent. up grade would reduce the speed by more than 25 per cent., and a ½ per cent. down grade would permit more than 50 per cent. increase in speed. True, the torque curve would slope slightly more in practice than fig. 4 indicates, as the current in the coils short-circuited by the brushes tends to bring about this result. If, however, the brushes are made broad enough to cause a useful slope in the characteristic, it will be at the cost of very low rotor efficiency at speeds other than synchronism. Again, even if the commutation were good enough to permit of the motor being started at full line voltage, the maximum tractive effort obtained would only be about seven times that corresponding to uniform motion on the level, and it would be impossible to maintain a high tractive effort until a considerable fraction of full speed was reached, as is done with the continuous current railway motor. Thus a motor having the characteristics shown in fig. 4 would not be suitable for suburban

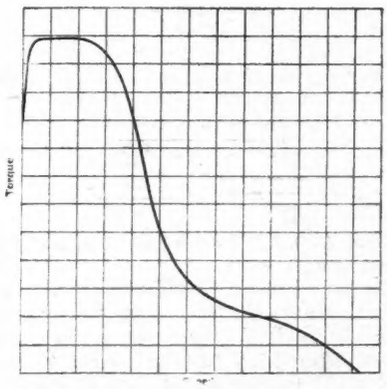


Fig. 7.

railway work, even if there were no grades, since in this class of work it is necessary to maintain a high rate of acceleration until a fairly high speed is reached, in order to permit good time to be made in spite of frequent stops.

We see, therefore, that if the repulsion motor is to be used for railway work, it must be robbed of much of its simplicity. The torque must be brought to a value suited to the grade by shifting the brushes with reference to the poles, by varying the terminal voltage, or by introducing a suitable series current into the armature through a second set of brushes. Whichever complication is employed, it is by a conscious effort on the part of the driver, rather than in virtue of the motor characteristic itself that the varying train resistance is taken care of, so that driving requires greater skill than when the continuous current series motor is employed. The Winter-Eichberg motor, as represented by its published characteristics,* shows no advantage over the simple repulsion motor in this respect.

The ideal railway motor would have a speed torque curve at constant voltage something like fig. 7. The torque, at starting, should be below the maximum value, in order to avoid an initial jerk. It should then rise rapidly to a suitable maximum value, and keep at this until a considerable fraction of full speed is reached. The maximum should be somewhat higher and longer maintained for local traffic with frequent stops than for long-distance traffic. After this the curve should droop, somewhat in the manner of a continuous current railway motor characteristic, which will cause the train to automatically adjust its speed on different grades, so as not to take excessive power. When free running speed has been passed, the curve may, with advantage, cross the line of zero torque, thus setting a limit to the natural speed of the motor, such that, if on a steep down grade this speed is surpassed, the motor will act as a brake to the train, and feed back energy into the line.

A motor having such a characteristic as is given in fig. 7 would offer considerable advantages for this class of work, especially in the simplicity of the controlling apparatus required, which would be reduced to little more than a reversing switch. There is nothing innately improbable in such a characteristic being obtained for an alternating current motor, and it is, therefore, well to keep the ideal in view when dealing with such motors.

* See Electrical Review, Vol. 53, page 852.

ACCIDENTS ON ELECTRIC RAILWAYS.

[by our legal contributor.]

Certain fatal accidents which have recently occurred owing to persons coming in contact with the live conductor on an electric railway, suggest nice questions of law to the legal mind. Leaving out of the consideration for the moment employés of the railway company, and others who have business on the permanent way, the first question is to consider whether the company can be held liable for injuries sustained by a trespasser on the rails. In finding the solution to this question, a sharp distinction has to be drawn between a tramway and an electric railway.

In the case of a tramway or light railway company who suspend naked conductors over streets and roads, there is a clear obligation to protect those of the public who are making lawful use of the road. If a wire were to fall and injure a passenger or other person by electric shock, the company would be held responsible. The position of a railway company is very different. They are using their own property, and they lay the live conductors in a position to which none save their own servants have any right of access. In these circumstances, if an accident takes place, is the company under any liability?

In order to decide the question, it is necessary to consider the liability of an ordinary railway company for injuries sustained by trespassers on their line. Take the case of a person crossing the line who is knocked down by a passing train. As he is a wrong-doer himself, and is guilty of culpable negligence, the law appears to be that he cannot make any claim. Strange to say, we have not been able to find any case which expressly decides the point, but the principle can be deduced from the following considerations:—

In the first place, it is provided by Sec. 23 of the regulation of Railways Act, 1868, that: "If any person shall be or pass upon any railway, except for the purpose of crossing the same at any authorised crossing, after having received warning by the company which works such railway, or by any of their agents or servants, not to go or pass thereon, every person so offending shall forfeit any sum not exceeding 40s. for every such offence." This section clearly makes a trespass upon a railway an illegal act, if the trespasser has received warning by notice or otherwise. It is conceived, however, that the absence of notice or warning would not be a sufficient justification for any person crossing the permanent way. In a case which was tried many years ago, an action was brought to recover damages for the death of a person who was found injured upon the line. There was no evidence to show how he got there. The company were held not liable (Singleton *v.* Eastern Counties Railway Co., 7 C.B.N.S., 287). Again, even assuming that the company can be held liable where one of their servants is injured, this liability cannot be artificially extended. So in the case of Woodley *v.* Metropolitan District Railway Co. (2 Ex. D. 384), a railway company was held not liable to the plaintiff, the servant of their contractor, for injury occasioned to him by their alleged negligence in the course of his employment on their line, the plaintiff knowing the danger of the employment.

There is one other aspect of the matter under discussion which merits attention. If stray cattle are injured on a railway, can the company be held liable? The answer to this question appears to depend on whether the company have discharged their statutory obligation to fence the line. Under 8 & 9 V. c. 20, s. 68, a railway company is bound to maintain sufficient fences for separating the land taken for the use of the railway from adjoining lands not taken, and protecting the cattle of the owners and occupiers from straying thereout. Hence, if a railway runs close to a highway, the separating fence must be so maintained as to prevent cattle lawfully passing along the highway from straying on to the line.

It may be noted, however, that if cattle stray from a field on to the highway, and from thence on to a railway, and are injured, their owner cannot prefer a successful claim, as the statute only compels the company to fence against cattle lawfully on the highway (Manchester, &c., Railway Co. *v.* Wallis, 14 C.B., 213).

Assuming, then, that an ordinary railway company is under no liability to a trespasser, it is difficult to see why any greater degree of liability should be imposed upon an electric railway. Near a level crossing, of course, or at any point where a public footpath runs across the metals, the company would not only have to place warning notices, but they would probably have to attach wooden guard rails to the live conductors in order to relieve themselves from any charge of negligence.

Owing to the fact that electric railways have been only recently introduced in this country, we have not been able to find any English case which bears upon the point. Certain American decisions, however, may be usefully referred to. They seem to accord with the principles above enunciated, and they certainly follow the well-known rule of English law that he who has the last chance of avoiding an accident is, *primâ facie*, the person liable therefor.

In a case which was decided in America a few years ago the defendants were the owners of a power station which was situated in grounds where there were certain naked conductors. Notices were posted on this ground to the effect that it was dangerous for persons to enter thereon, and there was no right of way across it. The plaintiff was the wife of a man who went to the power station one evening and met his death through coming in contact with a naked conductor. In an action brought by the widow to recover damages for the death of her husband, it was held that the company owed no duty to the deceased to guard the premises, and that the Judge was right in directing a verdict for the defendants.

In another case (Thomas *v.* Western Union Telegraph Co., 100 Mass. 156), it was held that if a live high-pressure wire sags down in a street and occasions injury to passers by, this is *primâ facie* evidence of negligence; but the conduct of the person injured—such, for instance, as his voluntarily touching the wire—may have been such as to contribute to the injury. In that case he could not recover.

THREE QUESTIONS FROM NEW ZEALAND, AND THE REPLIES.

The New Zealand Government has been asking the Board of Trade how it tells a good motorman when it sees him, and it would appear, from the introduction to the questions which the Government asks, that, up to the present, neither it nor anyone else in New Zealand has any idea. It says that electric traction has increased so much that it has become necessary, in the interests of public safety, to frame rules " . . . for the examination of motormen and conductors . . . " and it wants to know what we do in Great Britain—

1. As to the training prior to examination.
2. As to the various examinations and tests applied.
3. As to the periodical examinations subsequent to licensing.

The Government does not read its Review or the journals more particularly devoted to traction, or it would not have been the means of putting 40 tramway officials to a little trouble, of causing a much larger number certain qualms, and of laying the remainder open to the suspicion of surliness. There is reason to think that the inquiry was addressed to all and sundry, but replies from 36 only are included in the *précis* compiled by the Tramways and Light Railways Association (Official Circular, May). That is not a very hearty response to a simple application for help, and it rather tends to strengthen an impression that a large number of tramway undertakings are unable to give satisfactory replies to some or any of the three important questions. That they would be unwilling to reply if they were able to do so is improbable.

From the point of view of the critic, the *précis* mentioned above is too concise. In fact, the information has been reduced to the point of mutilation, and while attempting an analysis the desire for a sight of the original communications has been strong.

As regards physical examination, seven specify sight tests only, while six only state explicitly that a medical examination is enforced, and three state that none is required of their men. One undertaking of 35 route miles makes a yearly medical examination. Four, aggregating 35 route miles, make no reply to the question as to examinations for competence, and two boldly say that they make none, but the remainder have their motormen examined by the manager, inspectors, or depôt foreman. The third question stumps 17, for that number do not reply, and 10 others can only say that they make no periodical examination. Three more reply vaguely that their motormen "are kept under observation," while, one other says that they are tested "regularly," which means probably no time in particular. Two make yearly tests, and one little six-mile line professes to badger its men to the extent of *quarterly* tests. Possibly the manager is glad of something to do.

The fact is, that first examinations are not made on any well-defined lines, and are left too often to inspectors who themselves are not more competent than the men they profess to examine.

It is regrettable, but we are able to say with certainty that some managers are so little imbued with the idea of the vital nature of competence, that they see nothing strange in drafting practically raw men on to the road during holiday seasons, when more than at any other time, competence is required.

It is from the replies as to training that we have found particular difficulty in gleaning any very definite information. Out of the 36, eight train men "until they are fit to drive," that is to say, no hard and fast rule as to the time to be occupied by the process is made, which is logical enough. The egg of a goose is not boiled in the time taken to cook a hen's egg.

The answers of 16 are presented in such indefinite guise that it is impossible to tell what the training process is. Nine state clearly that the men are required to go into the car-sheds for a short time in order to familiarise them with the nature of an electrical equipment, the positions and functions of the component parts, their diseases and the remedies applied. To our minds this is a very valuable, indeed an essential, portion of the education of a motorman, and it is effected with the greatest ease. If the pupil is not paid for the remainder of his training he should be paid a labourer's wage while in the car-sheds, but it is not fair to allocate more than half his time to maintenance expenses. The rest should be debited to running expenses.

It is disappointing to find that no more than 25 per cent. of the undertakings before us consider it worth while to add this kind of knowledge to their drivers' equipment. We have heard various objections raised, and believe the following to be representative. One manager thought it foolish to give anything more to a motorman than would enable him to drive a car, as he would be training him for other people; for directly the man becomes "knowledgeable" above the usual, he will require more pay or go where he can get it. Another objected on the ground that a little knowledge is a dangerous thing, and he did not see why all the men should be electricians as well as drivers.

The fallacies staring through these and similar objections

to the manufacture of an efficient staff are so evident that it is quite unnecessary to dissect them. A locomotive driver is on a much higher grade than the majority of motormen, but we see just as good reasons for the latter knowing his car as that the driver should know his engine. The railway company takes very good care that its drivers are physically and mentally qualified for their responsible work, and the tramway undertaking has just as much interest in making, and obligation to make, the same high qualifications essential to the creation of their drivers.

To come back to New Zealand, we admire the thirst for knowledge of any Government, but we should like to know in the present case why the New Zealand Government wants this information.

Is it to be digested and afterwards circulated in the form of suggestions through the various tramways of the Colony, or is it to be made the basis of Acts or regulations by which the tramways are to be governed?

If the former—well and good. We can wish only that the Mother Country were able to show a better example.

If the latter, we cannot object too strongly. And we fear that the intention is sinister. The British Government is paternal to the verge of interference—some indeed go farther—but it has not yet proposed to order the condition of a motorman's stomach, or the celerity with which he shall dissipate so many foot-pounds of work at the brakes.

The Government may have heard that there is no recognised system of training motormen throughout Great Britain, but it has refrained so far from supplying the deficiency, acknowledging, maybe, that the matter, though affecting the public in some degree, is one with which it is not competent either from knowledge or right to deal. Common law and special regulations make it undesirable for tramways to encourage recklessness or incompetency, but it rests entirely with the proprietors of the tramways to set the standard of personal excellence.

Our railway service is not the worst or the most dangerous in the world, but the *personnel* has never been under the supervision of the Government; and we believe that any proposal to make a department responsible for licensing motormen would meet with very strenuous disapproval.

We hazard the opinion that the N.Z. Government is putting questions not so much on account of the "rapidly increasing use of electric traction," but more because of the increasing number of accidents, and that, like all Governments of that nature, it flies at once to the remedy of interference, with its burden of rules and more rules.

We suggest, instead, that it should look into the existing rules, and especially into the bye-laws, to make sure first whether what are there are kept, and, next, whether they are sufficient to cover the conditions existing in any one place. It would not surprise us to learn that regulations as to speed are either non-existent, or are not enforced; and, assuming that to be the case, the finest licensing system in the world will not prevent accidents, for the reckless driver cannot be kept out altogether, and managers will always get the most they are allowed out of their cars. While we think that the Board of Trade has been too conservative with its speeds, we certainly advocate restriction in that direction.

Managers and motormen may drive the cars faster than the speed laid down, but they do it at their own risk, and are more likely to use care when running at 20 miles per hour when the legal limit is 10 miles per hour, than they would when running at the same speed and with no specified limit. The majority of tramways in this country are bound down to a maximum speed of eight miles per hour, but it is only the poor system suffering very severely from slow motors which does not maintain—and publishes it, too—an average speed, including stops, of over seven miles per hour. Every tramway man knows what that means with regard to maximum speed. Yet the regulation is there, and every manager knows that, if a coroner's jury attributes a fatal accident to excessive speed, he may be held responsible for it, and he is correspondingly careful.

Our point is, that some regulations are good. They are all the better sometimes for not being kept strictly, but, before making new restrictions and taking new and onerous powers, it is well to see that the old ones are being applied, or that others on similar lines will not serve the same purpose less offensively.

The worst of interference is that it spreads if not choked in the beginning.

SIMPLE STORIES.

By "INNOCENS."

III.—B'rer Rabbit's Chimbley.

". . . We claim that, in any fire, not being a domestic fire, if its pure smoke (if I may use the term)—not black smoke, but the inevitable products of combustion—causes a nuisance, *i.e.*, discomfort, to any person, then, since a profit is made of such fires, the users thereof are bound to set aside part of the profit, and use it to mitigate the nuisance." (Counsel for Mayor, &c., of Westminster, *vide* Electrical Review, June 24th.)

One ebening, B'rer Rabbit, he went out foh a walk. He was feeling very pleased wid hisself, was B'rer Rabbit, 'case he'd invented a way of making iced drinks and skating rinks by boiling water in a kettle, and he was makin' money fast. So when he'd washed his face and brushed his tail, he went out for to do de elegant 'long de high road.

Now, he hadn't got far when he sees B'rer Fox coming down de road, and he sez to hisself, sezee, "B'rer Fox, you've a berry nasty look in your eye!" But he let on he didn't know nuffin', did B'rer Rabbit, and sezee, "Good ebenin', B'rer Fox! hope younh berry well!"

"No!" sez B'rer Fox, berry short, "No, I'm *not* berry well. De smoke from younh infunnel chimbley hab gibben me de opthalmia," sezee.

"Dat's berry funny," sez B'rer Rabbit, berry meek, "'case I'm usin' de best smokeless Welsh coal," sezee, "and a smokeless coal *can't* smoke," sezee.

B'rer Fox, he lifted his upper lip and showed his teef, but for a minute he didn't know what ter say. But he was berry cunning, was B'rer Fox, and he thunk berry hard, all de time pretending not to care nuffin. Presently he sez: "Well, B'rer Rabbit, I 'low dat younh lettin' some sulphuretted hydrogen out of dat chimbley of younhs, and you should know," sezee, "dat sulphuretted hydrogen is berry injurious to delicate constitushuns like mine," sezee.

B'rer Rabbit, he want ter smile, but he think he better not; and sezee: "B'rer Fox, dat am a mistake! I hab sot on de top ob my chimbley foh six houahs breeving nuffin but de smoke, and I'm as alive as ebber I was. Dere ain't no sulphuretted hydrogen *dere*," sezee.

B'rer Fox, he berry sick at dat, but he try to smile like's if he was laffin at his own mistake. "You hab me dere, B'rer Rabbit," sezee. "Dere *ain't* no sulphurretted hydrogen. When I said sulphuretted hydrogen I meant sulphurous acid," sezee.

Den B'rer Rabbit he fairly cough wid joy. "B'rer Fox," sezee, "I 'low I've had dat smoke analysed," sezee, "and dere's just decimal nought nought two six per cent. by weight ob sulphurous acid in it," sezee, "and if *dat* amount affects your constitution you must be berry delicate indeed," sezee.

B'rer Fox, he begin ter wave his tail, for he kinder felt excited. "'Tain't no sorter use talking like dat, B'rer Rabbit," sezee, "I can smell a berry disgustin' smell," sezee, "and your chimbley's too low and your boilers are leaking," sezee.

"B'rer Fox," sez B'rer Rabbit berry deliberate, "de chimbley am two hundred an' fohty feet high, and if you keer to step roun' an' find de leak in my boiler," sezee, "I'll be berry much obliged to you," sezee.

Den B'rer Fox he get berry mad, an' he open his mouf wide, an' he make one big rush at B'rer Rabbit an' knock him ober, ker-plunk! An' he put one foot on his chest. "Now, B'rer Rabbit," sezee, "you listen to reason. Younh chimbley hab offended me," sezee, "and I'm not gwaine ter stand it any moah. You gib me ten pounds down," sezee, "and an iced drink whenever I want it, or else I'll eat you up!"

B'rer Rabbit, he see dat de game was up, and he sez

berry pleadin', "Let me up, B'rer Fox, and I'll do jest's you want me. I reelize de force of youah argument as I nebber did befoah," sezee, "and I quite admit dat my chimbley *is* a nuisance," sezee, "and I'll stand you an iced drink ebbery time you want it, and here's de ten pounds," sezee.

ROYAL SOCIETY CONVERSAZIONE.

The second of the two annual conversaziones of the Royal Society was held at Burlington House on the 22nd ult., and there was the usual display of exhibits illustrating the latest advances in science.

One of the most interesting of the electrical exhibits was Mr. Duddell's ingenious thermo-galvanometer for measuring very small alternating currents. A very minute thermo-electric couple forms the lower bend of a loop of fine copper wire suspended by a quartz fibre between the poles of a magnet. The currents to be measured pass through a short platinum wire supported just below the thermo-electric couple. Alternating or direct currents passing through the platinum wire, heat it, and the heat radiated acting on the thermo-electric couple creates a current in the loop, which is thereupon deflected by the magnetic field. The deflection is indicated in the usual way by a mirror. This instrument is capable of measuring telephone currents, and also the currents in a wireless telegraph receiver. The great increase in the receiver currents due to tuning was illustrated by means of a small wireless telegraph installation fitted up in the rooms. This instrument will be of great value for investigating the best conditions for wireless telegraphy, the effect of obstructions and such like.

Prof. Schuster and Dr. Hemsalech exhibited an apparatus for the demonstration of oscillating electric discharges. The separation of the components of a slowly oscillating electric discharge was effected by blowing a steady current of air through it. The discharge passed between two slightly inclined metal plates, and spectroscopic examination showed the line spectrum of air in the initial discharge, and band spectrum of nitrogen in the oscillations. The metallic vapour from the electrodes did not seem to take part in the oscillations. The effect of introducing cores of iron or other metals into a coil may be illustrated by this arrangement.

The Hon. R. J. Strutt showed his remarkable apparatus for converting the energy of radium into mechanical motive power—the nearest approach to perpetual motion as yet invented by man. A small quantity of a radium salt in a glass tube is hung up by an insulated support in an exhausted vessel. A single gold-leaf electroscope is connected to the radium tube. The negative electrons shot off by the radium penetrate the glass tube, which is covered with a conducting coating of phosphoric acid, so as to act as an inductor. Thus, a positive charge is left, and causes the gold leaf to slowly diverge. When the gold leaf touches the earthed outer vessel it collapses, and begins again to charge up and to diverge. This will go on as long as the radium lasts.

Mr. W. Hibbert exhibited a new magnetic balance. The beam of the balance is made of a magnetised steel rod 27 centimetres long. The centres of the poles are 25 centimetres apart. The repellent pole of a second magnet being placed over one end of the beam causes this to descend, and the force of repulsion is balanced by a weight sliding on the other half of the beam. The absolute value of a pole in C.G.S. units can be ascertained in a very few minutes, without reference to the terrestrial or other field. The instrument can also be used for finding the approximate value of an electric current.

Mr. Killingworth Hedges exhibited photographs and drawings prepared from observations made by the Lightning Research Committee. They illustrated the effect of lightning on certain buildings struck and damaged, notwithstanding their being provided with lightning conductors.

The Physiotype, invented and exhibited by Mr. Francis Sheridan is a rather remarkable apparatus for copying patterns without the use of ink. Copies of leaves, lace, finger-prints, &c., were reproduced with marvellous accuracy, by simply pressing the article to be copied on a sheet of paper. The invisible impression thus produced is developed by rubbing a coloured powder over it, the powder being apparently attracted by the moisture left on the paper by the pattern.

A cylindrical telescope for the rotation of images was exhibited by Dr. G. J. Burch, F.R.S. The instrument consists of two cylindrical lenses with their axes of curvature parallel, and fixed in a tube at a distance apart equal to the sum of their focal lengths. Objects seen through this telescope are not magnified, but are reversed as by reflection in a mirror. A wheel spinning appears to revolve in the opposite direction. If the telescope is rotated, it causes the image to rotate with double the angular velocity. If the telescope tube is moved through an angle horizontally, the image is caused to move vertically up or down, or horizontally, or to remain stationary, according to the direction of the axes of curvature. The plane of polarisation retains its original direction unaffected by the rotation of the image.

Dr. Alan B. Green exhibited photographs to illustrate induced radio-activity of bacteria. Bacteria are killed by exposure to strong radium, but their corpses apparently retain enough of the excited activity to affect a photographic plate even through a double layer of lead foil.

Mrs. D. H. Scott has applied the kinematograph to record the growth and movement of plants. When these photographs are thrown in rapid succession on a screen, we have an acceleration of the flow of time, and the events of weeks are crowded into a few moments. The opening and closing of flowers and movements of stamens were shown. Another series showed the twining of two leaf stalks round a support during the week.

Mrs. Hertha Ayrton exhibited a striking apparatus for showing the origin and growth of ripple marks in sand. The layer of sand was placed in the bottom of a tank with glass sides. The tank was oscillated so as to produce stationary waves in the contained water. The first ripple in the sand appears at the point of maximum horizontal velocity. This is soon replaced by a pair of ripples on each side. Every ripple by causing a vortex in the water passing over the top soon builds up another ripple alongside of it. The whole processes were very attractively and clearly exhibited by Mrs. Ayrton's ingenious apparatus.

SUPERHEATED STEAM AND REHEATERS.

One of the papers presented at the June meeting of the American Society of Mechanical Engineers, by Mr. L. S. Marks, dealt with the use of superheat and reheaters in large compound engines. The author collected results of tests made during the past five years on large four-valve compound engines, and the comparison of the results throws light on the influence of the reheater, of moderate superheat, of load, of engine size, and of cylinder proportion. Nine engines and 28 tests are included, and all form parts of three electric light plants in or near Boston, U.S.A. As all but one of the engines had jet condensers, the feed water had to be measured, and all suitable precautions appear to have been taken to secure accuracy, making leakage tests to determine the rate of disappearance by leakage when all was at rest and steam simply kept up to full pressure.

In the first test of an engine with jackets and reheater and without, the reheater serving to superheat the steam 35° F., only 1·3 per cent. of economy was shown after making due allowance for the economy due to securing the jacket and reheater condensation at a high temperature. The chief benefit appears to arise from the use of the high-pressure jacket, and the reheater may even cause a loss.

On another engine, with surface condensation, ten tests were made, five with jackets and reheater, and loads from 0·25 to 1·25 times the full load. Four tests were made without jackets or reheater from 0·25 to 1·25 times full load, while one test was made with jackets and reheater and a higher pressure. There was slight superheat to the high-pressure cylinder, and about 50° of superheat was given in the low-pressure cylinder when the reheater was on.

These tests show gradual reduction of advantage with increase of load from the use of the reheater and jackets, as might be anticipated, and the actual saving is from 4 to 9 per cent.; but the reheater was insufficient to give much superheat, for while it gave 100° F. of superheat at quarter load, this fell to 75° at half load, 60° at three-quarter load, and 46° at full load, rising to 52° at 1¼ load, because of the reduced wetness, it may be supposed.

Testing another set of engines showed only 3 per cent. of economy at full load by using jackets and reheater, and the jacket appeared to be of no use at all if the initial superheat was 80° F. With a superheat of nearly 100°, the jacket and receiver in use

showed 4·5 per cent. economy, as compared with the same degree of superheat without jackets or reheater, but it would appear that this was due to the reheater effect, for the steam went to the low-pressure cylinder superheated no less than 60·5° F.

In a further set of tests, 7·5 per cent. was saved by jackets and reheater, and here, again, the initial superheat was about 90° at the boiler, and with the reheater 49° to the low-pressure cylinder. The same saving was found at both full and half-load. It is pretty conclusive that the reheater is of very little good without the aid of superheat.

The author's own conclusions as to high-pressure jackets and receivers are that the saving due to the jacket increases as cut-off is made earlier; decreases as the superheat of the initial steam is increased, and decreases as the engine becomes larger. These three conclusions, we may add, are consistent with reason and with the working theory of the steam engine that practical steam engineers have elaborated.

The author then goes on to say that the reheater is of no value unless it does more than dry the steam; and here, again, he seems on firm ground, for, if only dry steam is wanted, a separator will give this, and it does not pay to evaporate water by using damp steam to do so. The steam used in the reheater would have been better sent to the high-pressure cylinder. A reheater must be a superheater, and we should anticipate better results if the exhaust entered the reheater after it had passed a separator than if it carried with it all its load of water. Incidentally, we might add that the mechanical efficiency of various engines ranged from 91·4 to 94·1 so far as ascertained. The latter figure was only once recorded, and was probably slightly in error. About 93 per cent. was more common. No figures like 96 per cent. were forthcoming, such as were claimed for the Glasgow engines.

The author thinks that an initial superheat in the low-pressure cylinder will alone justify a reheater, and he considers that 100° of such superheat would probably maintain a dry exhaust. The steam was supplied by superheaters fitted in water-tube boilers, and only 100° to 125° of superheat could, of course, be obtained, which the author considers insufficient; he advises as the showing of this series of tests that a superheat of 150° F. should be employed, and even this will not prevent condensation in the second cylinder—if, indeed, it will do so in the first, though he showed that with jacket and superheat of 98° F. the dryness factor was 99 per cent. at cut-off, and 94 per cent. at release.

With regard to load variation where the steam was moderately superheated to both cylinders, the heat consumption per I.H.P.-hour was practically constant from half to full load and probably to considerable overload. This is very much on a par with the action of the Diesel engine, which, being hot inside, is in the condition of a superheated engine.

Superheating is thus seen to be particularly valuable for underloaded engines, and this is simply confirmatory of reasoning based on modern theories of the action of the steam and the metal of the cylinder.

Engines of large size appear to have an economy of about 10 per cent., *ceteris paribus*, over engines of one-third their size. This paper of Mr. Marks is an excellent one, and serves to emphasise and explain the facts and figures that have been published regarding the reheater, and to reconcile the different opinions formed from figures of tests.

Cylinder proportions within ordinary ratios of diameter and stroke have no marked effects on steam economy. The general moral is to keep things hot, but not to attempt to evaporate feed water by the use of steam.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

13,343. "Improved means for obtaining undirectional currents of high voltage." LA SOCIETE ANONYME WESTINGHOUSE. (Date applied for under Patents Act, 1901, June 17th, 1903, being date of application in France.) June 18th. (Complete.)

13,353. "Improvements in or relating to electrically-propelled vehicles." R. J. C. COLLINS. June 18th.

13,369. "Improvements in or relating to the electric-ignition apparatus of internal combustion engines." C. W. HIGGS, R. J. H. FOX, and T. B. HOPKINSON. June 13th.

13,370. "Improved casing for protecting electric leads." SIEMENS BROS. AND CO., LTD, and G. E. KERSS. June 18th. (Complete.)

13,389. "Improvements in electric arc lamps." A. ECKSTEIN and A. E. ANGOLD. June 14th.

13,424. "An automatic electrical apparatus for simultaneously locking and unlocking the doors of railway carriages." E. BARBER, W. H. PILKINGTON, F. AUSTERBERRY, and J. H. BELL. June 14th.

13,426. "Switching turntable." W. FAIRWEATHER. (The Brown Hoisting Machinery Co., U.S.) June 14th. (Complete.)

13,427. "Brake for overhead electrically-driven locomotives." W. FAIRWEATHER. (The Brown Hoisting Machinery Co., U.S.) June 14th. (Complete.)

13,428. "Electrical locomotive." W. FAIRWEATHER. (The Brown Hoisting Machinery Co., U.S.) June 14th. (Complete.)

13,430. "Means for operating overhead trolleys." W. FAIRWEATHER. (The Brown Hoisting Machinery Co., U.S.) June 14th. (Complete.)

13,433. "Improved process and apparatus for cleaning out accumulator batteries." H. HICKING. June 14th. (Complete.)

13,463. "An electric block signal system." L. C. WERNER. June 14th. (Complete.)

13,466. "Improvements in electric incandescent lamps." H. PLAUSON. June 14th.

13,468. "Improvements relating to electric switches." W. M. SCOTT. June 14th. (Date applied for under Patents Act, 1901, July 31st, 1903, being date of application in United States.) (Complete.)

13,470. "Improvements in electric plug and socket extensions." W. H. KELSEY. June 14th.

13,488. "Improved electric regulating apparatus of variable resistance and for direct reading." E. FAUVIN, E. AMIOT, and E. CHENEAUX. June 14th. (Date applied for under Patents Act, 1901, November 28th, 1903, being date of application in France.) (Complete.)

13,489. "Process of and apparatus for electrical separation." F. O. SCHNELLE. June 14th. (Date applied for under Patents Act, 1901, June 15th, 1903, being date of application in Germany.) (Complete.)

13,516. "Mechanical ear, used for the suspension of overhead trolley wire." W. E. TAYLOR. June 15th.

13,527. "Improvements relating to electrical measuring and indicating devices." G. HUGHES. June 15th.

13,532. "Improvements in and relating to the prevention of accidents on tramway systems through the breaking of overhead wires." J. MORGAN. June 15th.

13,543. "Improvements in electrical switches." A. P. LUNDBERG and G. C. LUNDBERG. June 15th.

13,564. "Improvements relating to the regulation of electric motors." THE JOHNSON-LUNDELL ELECTRIC TRACTION CO., LTD. (J. G. V. Lang, Germany.) June 15th. (Complete.)

13,567. "Improvements in envelopes for vapour electric conductors." E. WEINTRAUB. (Date applied for under Patents Act, 1901, June 15th, 1903, being date of application in United States.) June 15th. (Complete.)

13,569. "Improvements in electric controllers." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 15th.

13,570. "Improvements in controlling switches for electric circuits." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) June 15th.

13,585. "Improvements relating to electric motors." M. LATOUR. (Date applied for under Patents Act, 1901, June 19th, 1903, being date of application in France.) June 15th. (Complete.)

13,596. "Improvements in electric alarm clocks." F. W. BAYNE June 16th.

13,613. "An improved handle for rotary brushes and other devices driven by electricity." J. MACLEAN. June 16th.

13,643. "Improvements in and connected with signals in telephonic exchange." H. OPPENHEIMER. (Actien-Gesellschaft Mix & Genest, Germany.) June 16th.

13,686. "Improvements in clocks controlled by reversals of electric current." F. W. HOWORTH. (The Firm Magneta Fabrik Electr., Uhren.) June 16th.

13,698. "Improvements in and connected with electrical motor-starting switches." U. MORSFALL, J. CROWTHER and A. G. BROWN. June 17th.

13,706. "Improvements in apparatus for winding coils for continuous-current dynamo and motor electric machines." A. W. TOMKINS. June 17th.

13,720. "Improvements relating to electrical traction overhead conductor equipment." C. A. SCHIERWATER. June 17th.

13,724. "Improvements in electric drills." W. O. DUNTLEY. June 17th. (Complete.)

13,728. "A new or improved outside protector for the terminals of secondary or electrical storage batteries." S. G. PRINCE. June 17th.

13,736. "Improvements in apparatus employed for measuring wave lengths in wireless telegraphy." J. A. FLEMING. June 17th.

13,758. "Improvements in and relating to portable electric lamps." H. C. HUBBELL. (Date applied for under Patents Act, 1901, July 2nd, 1903, being date of application in United States.) June 17th. (Complete.)

13,759. "Process for the production of titanium from its oxygen compounds electrolytically." W. BORCHERS and W. HUPPERTZ. (Date applied for under Patents Act, 1901, June 18th, 1903, being date of application in Germany.) June 17th. (Complete.)

13,779. "Improvement in system of electrical distribution." G. S. DUNN. (Date applied for under Patents Act, 1901, June 18th, 1903, being date of application in United States.) June 17th. (Complete.)

13,806. "Improvements relating to electric ignition of internal combustion engines." F. W. ASTON. June 18th.

13,862. "Improvements in and relating to electric arc lighting systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts-Gesellschaft, Germany). June 18th.

13,864. "Improvements in and relating to the construction of dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts-Gesellschaft, Germany.) June 18th.

13,865. "Improvements in means for transforming the energy of alternating currents." E. WEINTRAUB. June 18th. (Date applied for under Patents Act, 1901, June 18th, 1903, being date of application in U.S.) (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

ELECTRIC ARC LAMPS. J. McLaughlin. 23,647. October 31st.

ELECTRIC SIGNALLING APPARATUS FOR RAILWAYS. F. Danneels. 23,750. November 2nd.

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RECTIFYING AND OBTAINING LIGHT FROM ALTERNATING ELECTRIC CURRENTS. E. Weintraub. 24,562. November 11th. (Date claimed under Patents Act, 1901, March 23rd, 1903, being date of application in United States.)

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